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Bad Effect of Prohibition

IN the article on Colorado highways, published in a recent issue, we read that the supply of convicts available for road work has decreased in Colorado since the state "went dry." Viewing the fact from our selfish interest in desiring the highway system of the country to be improved as fast as possible, our first impulse is to deplore the dethronement of King Alcohol. We have been strenuously fostering the use of the convicts on the roads. Now come some idealists, just as we are getting well started, to take away our beloved and useful convicts. In our calmer moments, however, we view the situation differently, and contemplate with undisguised pleasure the cleaner men, the happier homes which go hand in hand with the decrease in the number of convicts available for road work.

Standards for Municipal Work

THAT progress is being made in the adoption of standard units for reporting municipal work is evident from the committee report of A. Prescott Folwell, chairman, presented at the recent convention of the American Society of Municipal Improvements. Under present conditions it is not of much value to know that "pavement" in a certain city cost so much per square yard, when no thickness is specified and when the term "pavement" may, in one case, mean the wearing surface only and in another the wearing surface and the base. To bring order out of this chaotic state of affairs in reporting results the committee has proposed certain standard terms which make clear exactly what figures on city improvements mean. Thus far attention has been focused principally on paving and sewer work. The movement was commended in an editorial in the Engineering Record of July 1, page 3, and deserves the support of engineers throughout the country. A definite form of procedure in reporting results was decided upon some time ago, and the important thing now is to secure for the recommendations the publicity which they merit. Definitions on printed cards have already been distributed to the society's membership and to about two thousand city and town engineers, superintendents of streets and other officials. From the replies received it is apparent that in only a few cases have city engineers objected to the adoption of the units proposed. The usefulness of work of this sort is dependent upon a universal adoption of the principles involved. Engineers can make the committee's work effective not merely by commending it, but by actually using the methods advocated.

Something for Nothing

SOME of the low compensations engineers receive, and also some of the contempt in which laymen hold the profession generally, must be charged up to their methods of doing business. When it became known that Pontiac, Mich., with a population of 20,000 people, contemplated making expenditures for a sewage-disposal plant, outfall sewer and pumping station, several consulting engineers "went after" the business. Some of them made bona-fide offers to make a proper study of the situation and quoted what they considered a reasonable fee. To their surprise they were informed that other engineers, more than one firm, had already proposed to do the preliminary work *gratis* on the understanding that their plans would be paid for if accepted. In answer to a letter from the Engineering Record asking as to the status of the situation, George A. Brown, commissioner of public improvements, writes as follows: "Engineers have been over the ground and will make recommendations as to type, estimate, costs, etc. If their plan is adopted they will be paid on a 5-per cent basis; if not adopted the city will not pay for preliminary work." After the city officials have chosen the type the citizens will have to vote a bond issue to cover the cost. What chance of receiving an adequate compensation has the poor employee of the consulting engineer who gambles first on the caprice of the administration and then on an election? It is certain that not more than one of the competitors will be paid, and there is no assurance that anyone will be. Whether the proposal to get something for nothing came from the engineers or from the city officials, the moral effect on both parties is bad.

Research

THE importance of research work to our industrial future has been repeatedly pointed out in these columns. Recently the organization of the National Research Council has attracted attention throughout the country and much space has been given to it in the daily as well as in the technical and trade press. The sign is indeed a hopeful one and augurs well for the success of the council's work. There are many evidences that there is an awakening on this subject all along the line. One of the evidences is presented in the extracts, on page 552 of this issue, from a brief presented by engineering alumni of the University of Michigan to the board of regents of that institution. The document strongly urges the increase in the amount of research work at the university and its close co-ordination with industry. We can conceive of nothing that would be more beneficial to the industries of the nation than that a similar appreciation of the need of research work were had by the engineering alumni of every great institution, and that these alumni would take the pains to impress their views on the governing bodies of their colleges. The awakening needs to come in every walk of life. Standing close to each of the colleges must be industrial leaders with keen realization of what is to be gained by research work. In our national engineering and scientific societies there must be appreciation of their possibilities as mediators between the investigators and those who will use the fruit of research. Finally atop of all will be the National Research Council, co-ordinating and guiding, laying the broad plans that will lead us on to greater and greater industrial achievement.

Sound Advice on Bond Issues

ENGINEERS who report upon some much-needed public improvement and then see the bond issue for financing it buried by an avalanche of adverse votes on election day wonder why there is no justice in the world. Few of them realize that often the trouble is with themselves. Their reports, which should serve to enlighten the public on the broad general features of the project and its cost, are presented in a form which bewilders a man who has not had technical training. When a man does not know what he is voting for, he will generally vote "No." Failure of the engineer to present his case clearly has sounded the death knell of many a public improvement which, had it received proper publicity, would have gone through with flying colors. Much sound advice on the conduct of bond campaigns is contained in a booklet issued by R. E. McDonnell, of the firm of Burns & McDonnell, consulting engineers, of Kansas City, Mo. Some of Mr. McDonnell's arguments are in line with those which have frequently been enunciated by the Engineering Record in editorials advocating the improvement of engineering reports. The keynote of his remarks is contained in this sentence: "The real value of an engineer's service to the public comes in presenting his subject so clearly to the voters that everyone will see it, understand it, talk it and vote for it." As an aid to the understanding of technical matters, graphic methods always prove effective. Pictures are understandable even by untrained minds. Charts also can be employed to bring out ideas clearer than would words. As for the text portion of engineers' reports, Mr. McDonnell is correct in stating that the average engineer's effort is too long, dry and technical, and frequently leaves the official in doubt as to what to do next. The real job of raising the funds is as much the engineer's obligation as is the estimate of cost of the project. Engineers who report upon public-works improvements should read Mr. McDonnell's little treatise. They will find in it many suggestions which may be applied, with profit, to their own work.

Sewage Nomenclature

THERE is no need of pointing out the value of the work which the sanitary section of the American Public Health Association is doing in promulgating nomenclature in the field of sewerage and sewage disposal. At the Cincinnati convention last week the committee headed by George S. Webster submitted a tentative report defining terms commonly applied in this branch of engineering. Confusion has always existed in regard to the word "sewer." Is a conduit for storm water a sewer, or should this term be limited to lines carrying only domestic or industrial liquid waste? The committee proposes to differentiate the two types of carriers by means of the terms "sewer" and "drain," the latter referring only to conduits intended to carry storm surface and ground water.

Another moot point is raised by such terms as "sewage disposal," "sewage treatment" and "sewage purification." As for "sewage purification," if our recollection is correct, Professor Whipple of Harvard University recommended the abandonment of this term some years ago. The same position is taken by the American Public Health Association's committee. "Sewage disposal," according to the recent recommendations, is to be considered as a generic term applied to the act of disposing of sewage by any method. "Sewage treatment," on the other hand, is the process to which sewage is subjected in order partly to remove its impurities and render it fit for final discharge.

Under the heading "Tank Treatment" the committee suggests a dual designation—Imhoff or Emscher—for the type of two-story construction which during recent years has attained such wide popularity in this country and in Germany. To the Engineering Record it is not clear why two names should be sanctioned for a single type of apparatus. As this journal interprets the work of the committee, its chief function is to eliminate ambiguity in the use of sewage terms. The Imhoff and the Emscher tank is one and the same thing. Why, then, the two names for it? One would serve the purpose adequately and would eliminate any confusion, particularly in the minds of laymen who, in reading reports, might conclude that the Imhoff and the Emscher tanks were two distinct forms of equipment.

General usage in this country favors the expression "Imhoff tank," named after its inventor. When the committee undertakes the final revision of its report—which is understood to be merely suggestive at present—it would be desirable to have only one name for the two-story tank—the Imhoff tank.

Competition Versus Monopoly in Public-Utility Operation

MR. GALLOWAY'S article on page 561 of this issue advances some views not often heard. Fortified by general experience, we seldom question the advantages of protected monopoly, as against competition, in public-utility ownership and operation. In fact, monopoly in this type of enterprise, combined with governmental regulation, has been crystallized into the laws of the land.

Reduced to the simplest terms, Mr. Galloway's protest is against over-regulation. "There is a middle course in all things," said the old Roman proverb, and to just this Mr. Galloway's views reduce. The thought when applied to public-utility regulation is not new. Mr. Galloway sees in over-regulation, however, more than inconvenience for the utility manager. To him it means the stifling of individual initiative and a consequent weakening of the forces responsible for American achievement.

Undoubtedly there are grounds for his fears. We are in a state of flux with reference to public-utility regulation. What the ultimate form will be, what the character of supervision, only the future can tell. Certainly if the ultimate result is going to be one that will work for the best interests of the whole people, the danger that Mr. Galloway sees must be clearly appreciated.

The specific plea made by Mr. Galloway is for competition, as opposed to monopoly, in public-utility regulation. He sees in protected monopoly danger of plants and systems falling to a low degree of efficiency because the stimulus afforded by competition is removed.

As in the broader matters, there are grounds here for Mr. Galloway's fears. While with competition stifled there is not the direct incentive to invention, the present policy of regulation, forcing as it does improvement upon improvement and expenditure upon expenditure, at the same time crowding the return on the property down to a minimum, provides an indirect stimulus for discovering new methods and new economies.

And without going to the length of again establishing competitive conditions, it is possible, under monopoly, to stimulate utilities to still higher efficiency. It cannot be done when the maximum allowable earning is put upon a fixed percentage basis. The utility owners, as well as the public, must be allowed to share in the economies. Franchises of this sort have been drawn up and must eventually become universal.

Moreover, past experience has condemned competition in the public-utility field. To throw aside this experience and revert to competitive conditions is to invite further experimentation, further turmoil, and to put off the day of sound handling of this difficult problem.

It is conceivable that a turn of affairs may come in which it will be considered desirable to again permit competition in the public-utility field. Such a turn, though, cannot now be foreseen. Should competition, however, be re-established the investment will be greater than under present conditions, and a larger profit must necessarily be allowed the competing companies. Mr. Galloway, reverting to this subject, brushes aside lightly the matter of duplicate plants, but he does so, in our judgment, without warrant.

While, then, this journal cannot agree with Mr. Galloway in his particular plea, it does believe that a presentation of such views has value in the work of developing a sane and adequate public-regulation policy. If only conventional views are presented, if those who see danger ahead are silent, if abuses are not uncovered, the world will stand still. Public-utility regulation is still in its infancy. Conditions border on the chaotic. There is no unity of theory or policy in the work of the state commissions. Out of the experimentation, out of the variety of theory, will eventually come a policy that will meet our conditions, that will safeguard the interests of the public as well as those of the utility investor. To believe less is to lack faith in our ability successfully to meet the problems of democracy.

Government Ownership for England

ENGLAND has about the highest railroad rates in the world. English railroads, on the other hand, pay comparatively low wages and dividends. England, therefore, of all countries, might be expected to afford the strongest arguments for government ownership as a panacea for private inefficiency. In fact, there is much agitation there for nationalization of the railroads after the war. The London *Engineer* does not accept the arguments. Apologizing for repeating trite facts, on the ground that the government-ownership proponents cling to their old themes, the *Engineer* points out why English rates are high and English dividends low, and contends that nationalization offers little or no remedy for the conditions.

The Engineering Record repeats the apology and the facts for the same reason. Ton-mile costs vary inversely with the average haul. In England this average haul is short. In the United States, where, as the *Engineer* points out, the lowest ton-mile rates in the world prevail, the average haul is long. On the other hand, if the rate per mile is high in England the miles are few, and the *Engineer* thinks the rate grievance is therefore exaggerated. As to dividends, it is pointed out that the English railroads are highly capitalized because they were expensive to build—being expensive to build because of the high pioneer prices for materials, the high cost of land and the continuous public opposition to railway development.

The sum and substance of the *Engineer's* argument is that rates and dividends are based fundamentally on conditions quite apart from the question of private or public ownership. Applying the theory to the United States it might be said that our rates are low because of long haul, and in spite of private ownership. The first part of this is unquestionably true—but so long as rates are low, for whatever reason, and so long as so many evidences of government extravagance and inefficiency are seen about us, it seems the part of wisdom to let well enough alone.

Politics and Highways

THE New York State Highway Department has been dragged into the present political campaign. The Democratic candidate for governor has said that the highways were never in worse condition; the governor's campaign book, on the other hand, takes undue credit for the department's work and casts aspersion on the management of the department under his Democratic predecessor. Both candidates are in the wrong. The state as a whole would have been the gainer had they been silent about the highway department and left it where it has been to a great extent in the last four years—out of politics.

Time was when the highway work of the state was honeycombed with graft and inefficiency. It was a political football. The organization was demoralized. Four years ago a change for the better began. John N. Carlisle was made commissioner. The strong political control of the department was broken. Efficient division engineers were chosen and given competent subordinates. In less than two years the organization was remade. An *esprit de corps* that was admirable replaced the demoralization. The funds were efficiently spent, the roads of the state greatly improved.

This better organization the present administration inherited and, in the main, retained. Some changes were made, certain appointments were political—and these the adherents of the former administration condemned. The appointments, however, were good ones, the appointees competent. The good work of the department has been continued. It will increase still more in efficiency if the organization is left to work out its destiny as an engineering body—if politicians will leave hands off.

As to the conditions of the roads, the testimony of experienced highway engineers gathered by this journal controverts the Democratic candidate's statement. The roads are in better condition as a whole than they have been before. It is true that in the spring of this year conditions were bad. The late winter was exceptionally hard on the roads. There were repeated thaws followed by hard frosts. In addition, when the working season opened, it was almost impossible to secure labor. As a consequence, the work of repairing the winter's damage was dragged out much longer than usual. Long since, however, the work has been caught up.

The department has made such progress in recent years that it is a pity that unwarranted statements have been made—especially when intended for political effect. What troubles the highway department did have years ago were due entirely to political machination. The department to-day is well organized. It is doing good work. It will do still better work in the future if politicians will give it credit for what it has done, and, for the good of the state, endeavor to increase its efficiency and not use it for personal and political aggrandizement.

Electric Welding Possibilities

CONCEDING that the suggested use of the electric spot weld in the field of structural engineering as outlined by Mr. Hinckley in the article on page 524 of last week's issue is in the nature of a prediction that cannot be wholly justified by existing facts, nevertheless it should arouse the profession to a more active interest in the immediate further development of experimental data. Whether the recent rapid growth in the applications of the electric spot weld will continue to that degree which will make the process a really economical competitor of the riveted joint in the next few years is doubtful.

Limitations in thickness will handicap the process so that the economy which might otherwise be effected in long-span structures where decrease in dead load is a large item can hardly be expected in the near future. Furthermore, there are inherent weaknesses in welded joints due to the impossibility of adequate inspection and the danger from brittleness and sudden failure under impact. Structural engineers would hesitate before using welded joints in structures subjected to the action of moving loads unless it could be absolutely demonstrated by uniform results of an extensive investigation that the steel actually flows together and is not hardened and made unreliable by the process.

Discussing with commercial producers of the welding machines the possibilities suggested by Mr. Hinckley, it is significant that even the most optimistic and interested manufacturers are not yet willing to predict any immediate invasion of the structural field by the spot-weld process. Recognizing, however, that with the development of electrical resources and the increased efficiency possible in welding processes there may be opened up immense fields for more economical fabrication of steelwork, it is strongly urged that scientific and reliable investigations be conducted as suggested by Mr. Hinckley in order to insure the earliest possible further effective application of these new processes.

Inasmuch as the commercial introduction of welded structural steel, like everything else, will proceed commensurately with the growth of public confidence in its merits, manifestly the first important steps to be taken are those necessary for convincing the structural profession in general as to these merits, to accomplish which the creation of a widening interest in the subject is first essential. It is expected that the assertions and claims in the article will provoke a certain amount of discussion and criticism, adverse as well as otherwise, in which case it will have accomplished its purpose.

No Health Menace in Street Cleaning

WHAT is characterized as "the most valuable body of facts and opinion now extant upon the sanitary aspect of street cleaning and street dirt" is contained in the report of the committee on street cleaning presented last week to the sanitary section of the American Public Health Association at its annual convention in Cincinnati. The fact that S. Whinery, consulting engineer, of New York, acted as chairman of this committee presupposes a thorough and intelligent investigation of the subject, and in this respect the reader's expectations are amply fulfilled.

The report is somewhat different from others in this general field. It is confined to the human, rather than to the technical, elements of the problem. It deals not with street-cleaning methods or costs, but with the effect of street dirt and dust upon the health of employees charged with its collection and of the public in general. The committee's findings are largely negative. Conclusions based upon a questionnaire to officials of street cleaning and health departments, hospitals and life-insurance companies in American and Canadian cities having a population exceeding 100,000 indicate that street cleaning and the work connected therewith are not more unhealthful than other laboring occupations. Since those most directly and constantly exposed to street dirt seem to be as healthy as other classes, the inference is that the danger to the public at large cannot be very great insofar as the street dirt is concerned. In the finely divided dust, however, the chief influence upon public health seems to lie.

In view of this statement, it is necessary to revise the popular conception of the health menace in work of this sort. It has been commonly believed that continued exposure to street dust—a condition common in the work of hand-sweepers, operators of sweeping machines and men collecting and disposing of street waste—is particularly conducive to tuberculosis. This assumption is not borne out by the facts. For example, statistics from the New York Street Cleaning Department, covering a period of six years, show an average death rate of 14.8 per thousand, while the records of the New York Health Department for the same period show that the average death rate for all males between the ages of 20 and 70 years was 15 per thousand. Figures from the records of one large life-insurance company support the view that street cleaning cannot be considered as an unhealthful vocational employment, but another company takes the opposite view.

There appears to be a decided paucity of actual records upon which to base conclusions. The number of replies received in answer to the questionnaire is, according to the committee, "disappointing." Reliable conclusions can be reached only if street-cleaning and public-health departments provide and maintain adequate systems of observation and records from which can be determined the true sanitary aspect of street dirt and street cleaning.

Large Steel-Frame Ship Shed Contains Special Trusses Designed for Vertical and Horizontal Crane Loading

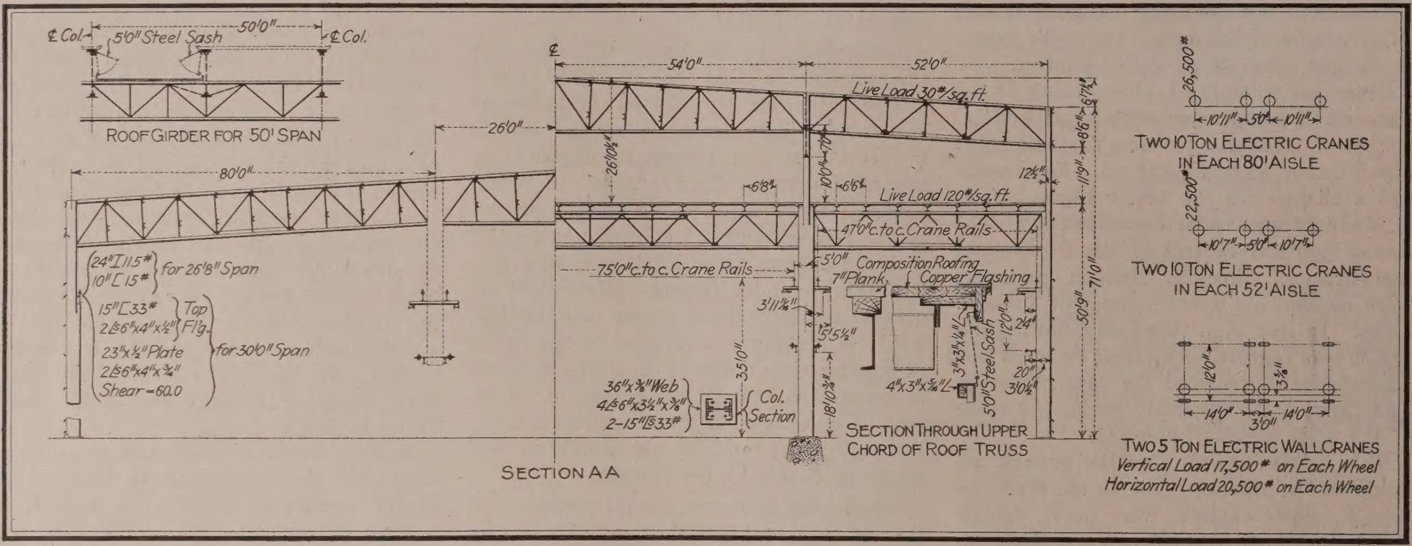
William Cramp Shipbuilding Company's New Structure in Philadelphia Planned to Give Maximum Clear Floor Space and Provide for Traveling Wall Cranes Throughout Length of 540 Feet

DEEP longitudinal trusses having horizontal plate girders as lower chords and at mid-height to resist the horizontal thrusts of a 5-ton wall crane, designed with particular reference to economy, are notable features of the large ship-shed building recently erected for the William Cramp & Sons Ship & Engine Building Company in Philadelphia. Trusses varying in span length from 40 to 80 ft. not only support these wall crane loads but also carry the main 10-ton traveling cranes, the second floor loads on the top chords and the roof trusses. The use of such unusual trusses was necessary to meet the requirements for large unrestricted working spaces on the first floor.

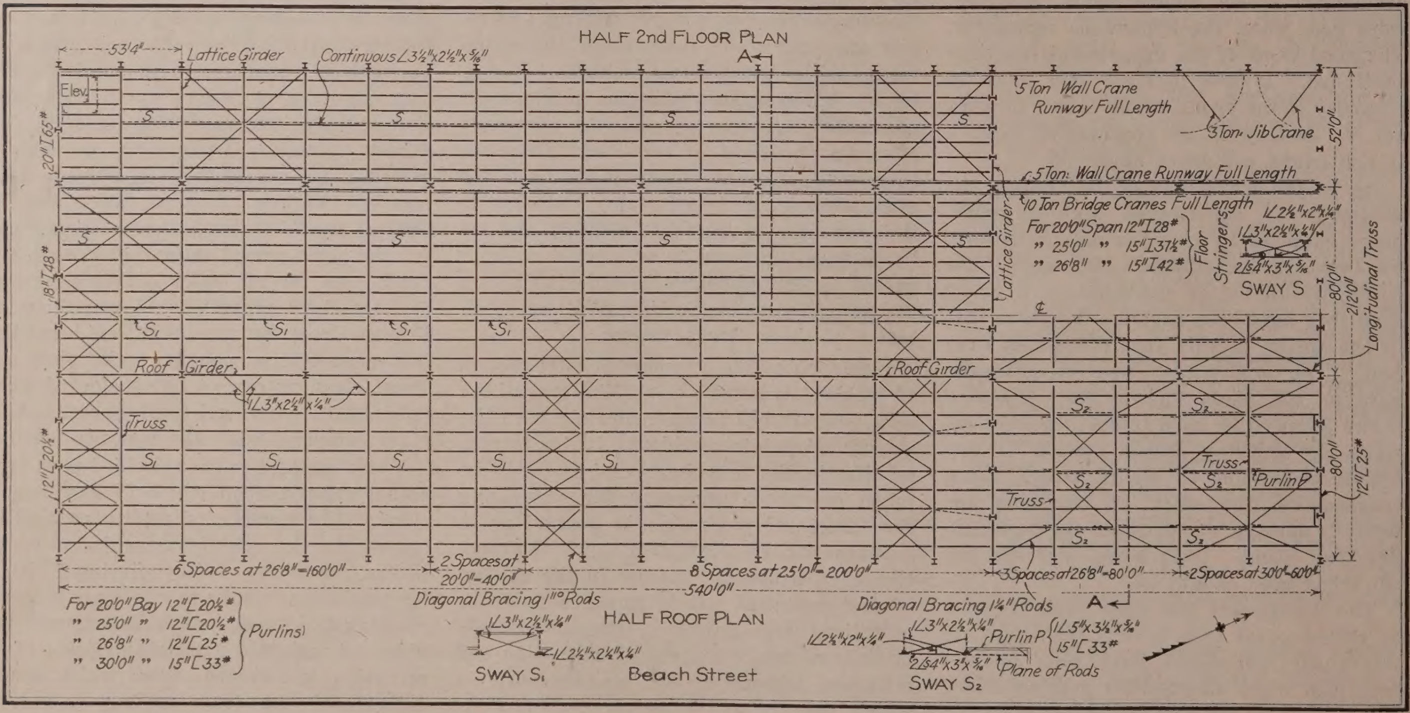
Aside from the special design features of this building, its size of 212 x 540 ft. in plan classes it among the largest of such steel-frame structures in the country used exclusively for ship and engine building. Two bays at one end, occupying a total length of 140 ft., contain the anglesmith department in the 60-ft. bay, and in the 80-ft. bay are two long furnaces for heating angles and one large plate furnace, all of the oil-burning type; while in front of the furnaces for working the miscellaneous materials is a cast-iron machined floor.

The remainder of the building, 400-ft. long, has a concrete floor. On this floor are located the miscellaneous punches, shears, rolls, planers, drills, countersinks, hydraulic benders, jogglers, etc., on which all the material is worked up for the hulls of the ships, ready for assembling. On the second floor, in a space 212 ft. wide by 400 ft. long, is the mold loft. Special attention was given to daylight lighting, and in this large area the center of the floor is as well lighted as along the sides. This is necessary to enable the workmen to lay out to full size the lines of the ships for making the necessary templates and molds, after which they are used on the floor below in getting out the plates and shapes to the proper size.

The total 540-ft. length of the building, 400 ft. of which is two stories in height, is divided into twenty-one bays, varying from



HALF-SECTIONS OF BUILDING SHOW LATTICED GIRDERS AND ROOF GIRDERS—CRANE-WHEEL LOADS SPECIFIED

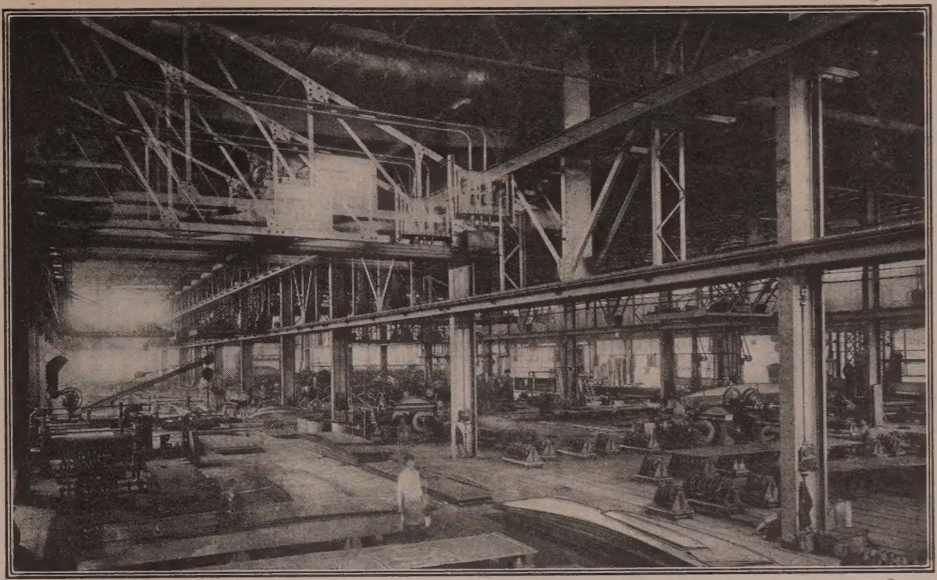


HALF-PLAN VIEWS OF ROOF AND SECOND FLOOR GIVE LOCATION OF TRUSSES AND LATTICED GIRDERS

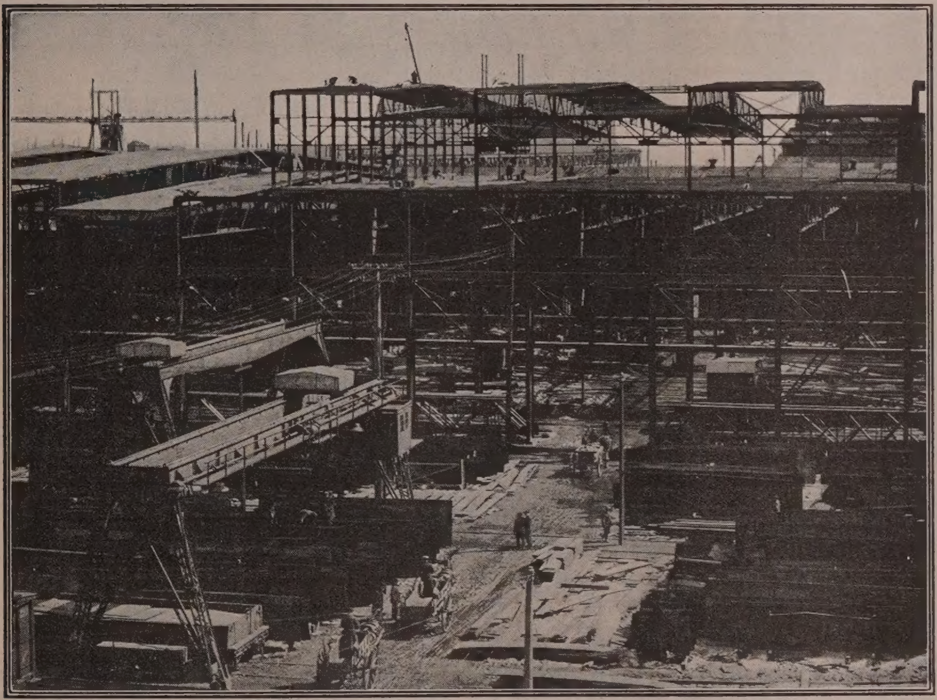
20 ft. to 30 ft. for the exterior-column spacing and from 40 ft. to 80 ft. for the interior-column spacing. The building is unsymmetrical transversely, being divided into two 80-ft. aisles and one 52-ft. aisle, as indicated by the accompanying plan and sections showing the general layout of columns, trusses, crane runways and second floor framing.

Electric Traveling Cranes

Each aisle is provided throughout its length with the usual type of electric traveling cranes of 10-ton capacity. In addition, the entire building (except for the east wall in the low-roof portion) is furnished with 5-ton wall cranes, necessitating wall trusses and interior trusses with longitudinal girders in horizontal position, greatly complicating the design and the structural details. Small jib cranes are located as shown, and are attached to the columns only at the level of the lower runway girder.



INTERIOR VIEW OF COMPLETED BUILDING SHOWS WALL CRANES AND FABRICATING MACHINERY



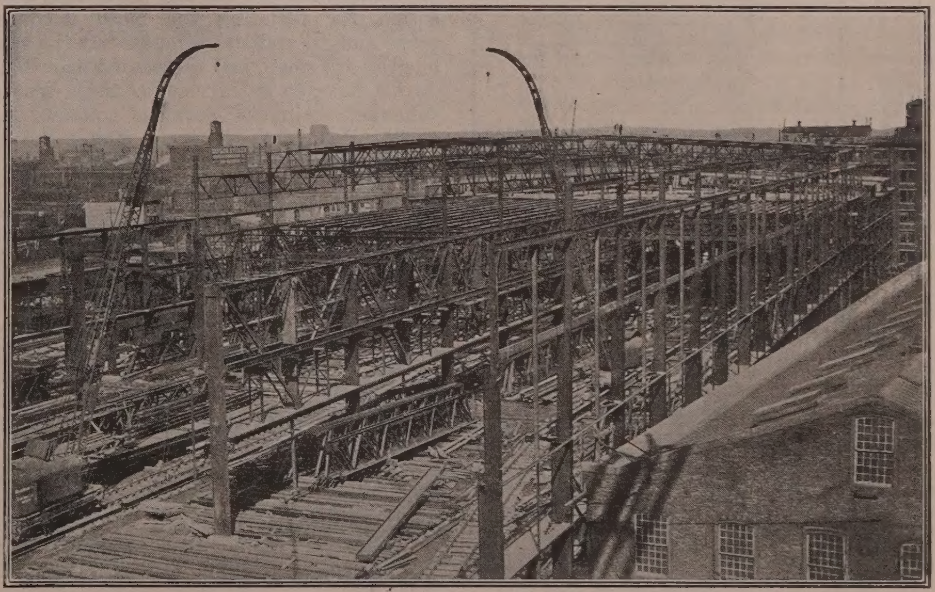
LOFT IS LIGHTED BY CONTINUOUS SASH IN HIGH-LOW TYPE OF ROOF

The timber flooring of the second floor rests upon I-beam stringers, supported by latticed girders. The usual type of triangular truss carries the plank roof on steel channel purlins. The high-low type of roof, with 5-ft. steel sash, was adopted to insure good lighting as required throughout the floor.

The live loads specified for the building are noted on the main sections, with diagrams giving the crane-wheel loads and spacing. Unit stresses as prescribed by the Philadelphia building law governed the design.

Details of 50-Foot Truss

Typical details of one of the interior longitudinal trusses (50-ft. span) are shown in one of the drawings herewith. The top-chord angles support the floor, and were therefore designed to resist both bending and direct compression. The main vertical crane loads are carried by 18-in. I-beams in 50-ft. lengths spanning the 12 ft. 6 in. between panel points at mid-height of truss. The vertical loads of the wall cranes are supported by 15-in. I-beams similarly detailed, but connected to the truss at the panel points by transverse 12-in. channels.

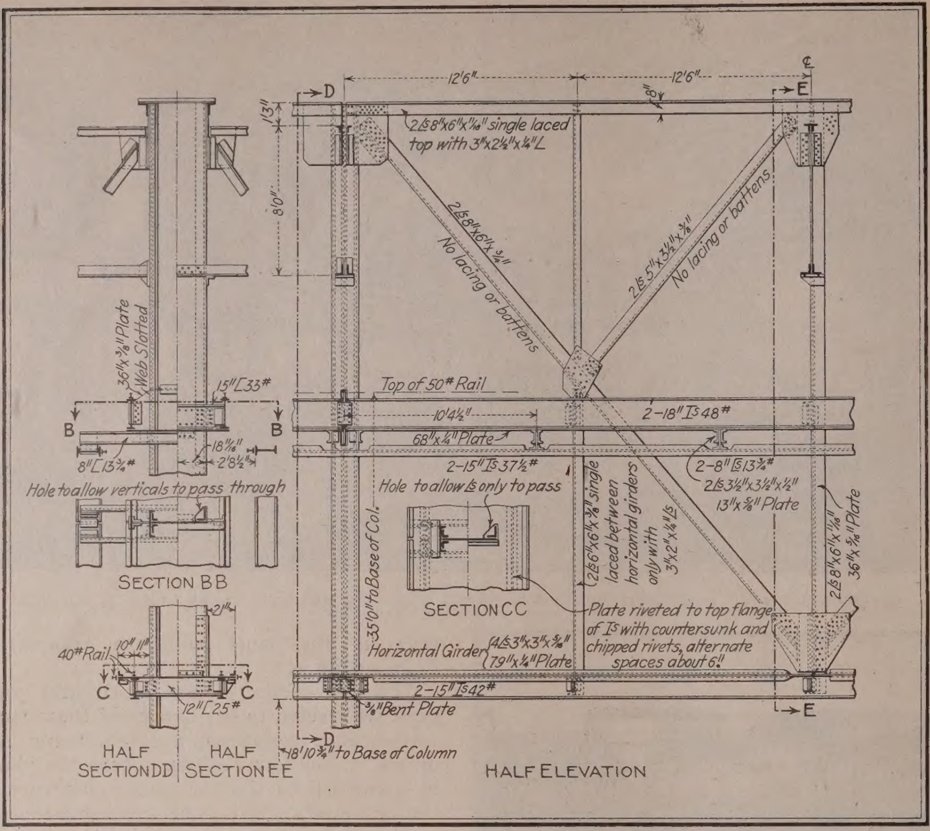


PROGRESS PHOTOGRAPH TAKEN MARCH 11—TRUSSES WITH WALL-CRANE RUNWAYS

The web-plates of the horizontal girders are riveted to the flanges of these runway beams, countersunk rivets being required in the lower girder where the plate is connected to the top flange underneath the crane rail. The upper horizontal loads of the wall crane are carried by horizontal 15-in. I-beams spanning about 10 ft. between transverse pairs of 8-in. channels riveted to the horizontal girder. The lower flanges of the longitudinal crane beams act as flanges for the upper horizontal girders. The lower horizontal loads are carried directly by the horizontal girders consisting of four angles and a web plate, with the 40-lb. rails connected to the flange angles, as shown in the details.

Erection Complications

The details of the connections, indicated by the various sections on drawings herewith, are complicated by the erection requirements, the separate field pieces being shown on the drawing by the location of field holes. Slotted holes in the horizontal web plates were necessary to allow truss members to pass through, as noted, and all clips, gussets, etc., on members below the



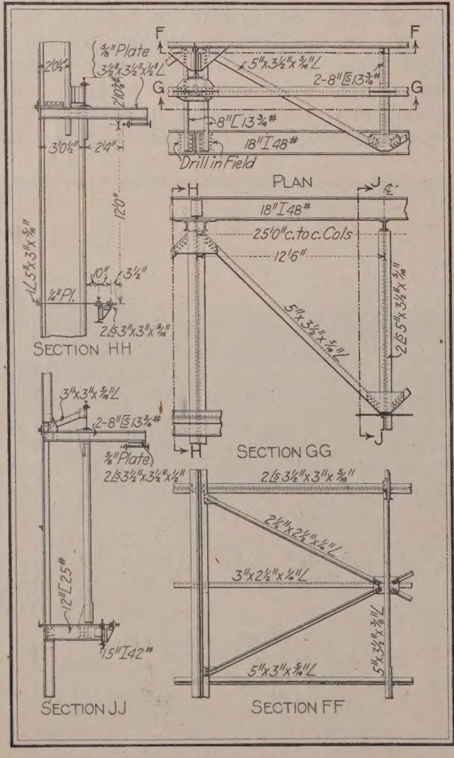
HALF ELEVATION AND SECTIONS OF INTERIOR 50-FOOT LONGITUDINAL TRUSS

Material for truss between 80-ft. aisles is given. Truss between 80-ft. and 52-ft. aisles is same on 80-ft. side, with lighter material on 52-ft. side

upper plate were omitted until after erection. The main diagonal angles are passed through slots in the horizontal plate of the upper girder, and are not laced or battened together.

ECONOMY IN WEIGHT

The other longitudinal trusses, varying in span length from 40 ft. up to 80 ft., and having panel lengths of 10 ft., 13 ft. 4 in. and 15 ft. respectively, are designed with details similar to the 50-ft. truss described. The interior trusses between the two 80-ft. aisles are symmetrical about the central longitudinal plane; but to attain maximum economy for these trusses located between the 80-ft. and 52-ft. aisles the angles used on the 52-ft. side are decreased in thickness to carry the smaller loads from that side. In other words, the two sides of the trusses are assumed to act independently under full loading in the adjacent aisles. In this connection, the omission of lacing and battens in the diagonals should be noted.



TYPICAL SIDE-WALL TRUSS—25-FOOT BAY

SIDE WALL TRUSSES

The details of the 25-ft. side-wall trusses are also shown herewith, these trusses varying in length from 20 ft. up to 30 ft. and providing both vertical and horizontal beam action for resisting the main traveling crane and the wall crane loads. As the span lengths are small, and the second floor loads do not have to be carried by these trusses (channel stringers between columns are used), they are relatively simple in design. The runway beam acts as the top chord of the truss, the plane of which coincides with this beam. Instead of a web plate for the top horizontal girder, diagonal angles are used below the main runway beam. The horizontal I-beam is supported at the center of the bay by the two 8-in. channels indicated in the plan view. The lower horizontal loads of the wall crane are carried by a web plate and three angles for flanges, two on the inside, to which the crane rail is attached, and one on the outside.

The building was designed, fabricated and erected by the American Bridge Company, as approved by H. W. Scott, engineer of plant for the William Cramp & Sons Ship & Engine Building Company, of Philadelphia.

Urge Advanced Research on Public Problems

Composite Opinion of Alumni of University of Michigan Also Advocates Publication of Results in Permanent Form

THAT advanced collegiate work, and more especially advanced technical research on public and industrial problems, are vital and should be encouraged is the practically unanimous opinion of the engineering alumni of the University of Michigan. They believe that the state could well co-operate in the establishing of a state bureau of standards. They also believe that the results of research should be published in permanent form through the creation of a university press. These and other points are brought out in a report submitted last June by the Chicago Engineering Alumni to the president and board of regents of the university. The report is presented as a composite opinion of 524 alumni of all ages, the responses from the classes prior to 1870 being proportionally the most numerous. The investigation was handled by the Chicago Engineering Alumni through a committee of thirty-one, of which Sutton Van Pelt was chairman.

FACILITIES ALREADY AVAILABLE

On the subject of technical research the committee points with commendation to the facilities already available, which include the naval testing tank, the new automobile testing laboratory, the chemical laboratory, the highway laboratory, the sanitary experiment station, the mechanical engineering laboratory and the electrical laboratories. It also calls attention to the survey of St. Clair flats, lake surveys, triangulation of waterways, consultation in water supply and sanitation in numerous cities and the appraisal of public-utility properties totaling $1,300,000,000 in value, and thinks that considering the equipment available the College of Engineering has already done unusual service of unquestioned practical as well as scientific value. That much more, however, in the opinion of the alumni can be accomplished is indicated by these extracts from the report:

"To achieve the necessary breadth of viewpoint, members of the faculty are very properly permitted and encouraged to engage in outside consulting work, and the board of regents is to be commended heartily for its foresight in making this possible. What now seems to be most urgently needed is the separation of graduate and undergraduate work with more space and more equipment, so that advanced technical research may be prosecuted along distinct lines suggested by the most urgent needs of the country's industries. It is hardly to be doubted that the desired outside support would then be available.

"We consider it essential, to render such research of maximum value, that the results be published in permanent form. Should casual publication in magazines and technical society proceedings be depended upon, much good work could hardly hope to find a place of record.

FIELD FOR BUREAU OF RESEARCH

"Finally there exist very important and pressing research problems of a broader nature, which could well receive attention either by the Graduate School, or by the Bureau of Research—such as the technical phases of city planning, administrative efficiency in cities, public utilities and industries, etc. Carrying this idea to its logical conclusion, it should also be possible for the state to repose in such a research bureau as contemplated such functions as would cause it to become a state bureau of standards, thus encouraging standardized precision work.

"Only recently a movement has been inaugurated in one of the American technical societies by which such local research and standardization bureaus should be co-ordinated under the control of a central research organization. . . . The idea is fully as applicable to normal industrial development, and it is quite in accordance with the principles of conservation of resources which this country has definitely accepted."

In slightly condensed form the recommendations of the committee are as follows:

1. That a comparative inquiry be conducted into the work of the College of Engineering and Architecture, the professional standing of its graduates, the compensation of its faculty members in view of the demand from the industries for technically trained men, the equipment and building facilities for both graduate and undergraduate work and the ways and means whereby the integrity of graduate degrees may be best maintained along with adequate undergraduate instruction.

2. That a distinct department of technical research be organized on some plan sufficiently flexible that the laboratories may be developed either as separate units when funds are limited, or more centralized, as may be found more practicable.

3. That a university press be established publishing the results of technical research, as well as the work of other colleges.

4. That intense study be devoted to the immediate needs and opportunities of service to the state and the industries, and that every possible means of encouraging their co-operation be adopted.

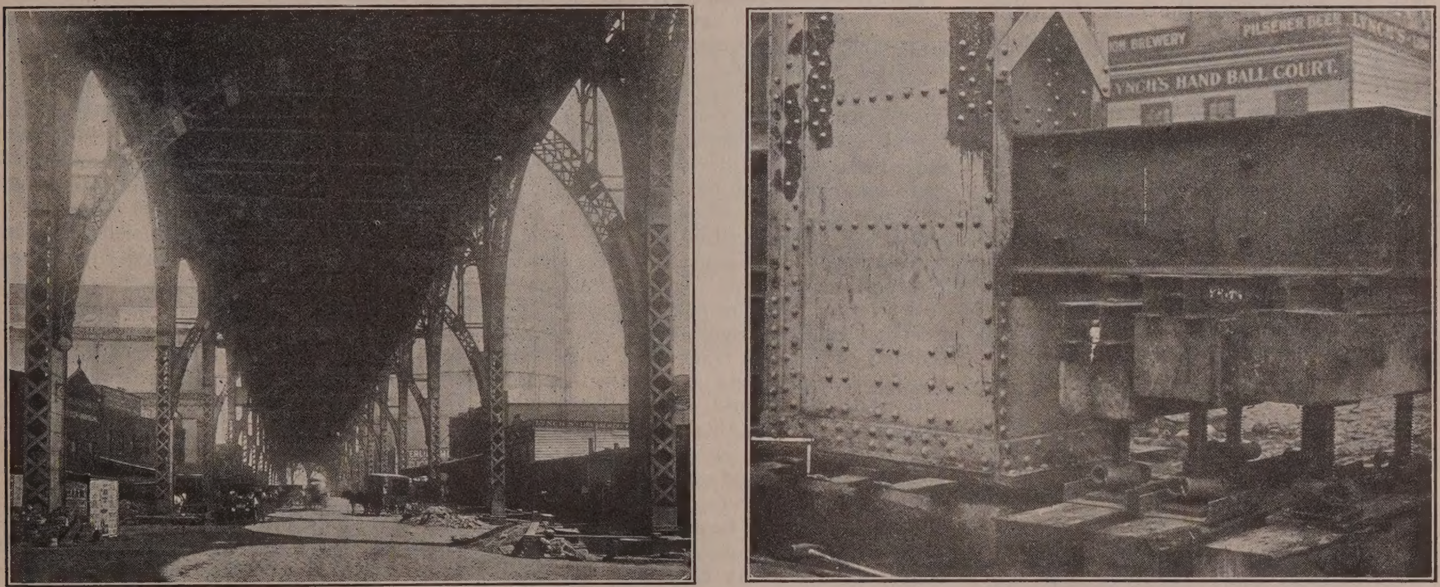
5. That attention be given to directing this work into the channels of special usefulness for the furtherance of foreign trade relations, especially with Pan-American countries.

6. That inquiries be made to ascertain the possible field of immediate co-operation with such organized bodies as the Naval Advisory Board and the various engineering societies and commercial bodies for the most efficient organization of technical research throughout the country.

Raise Settled Columns of Big New York Viaduct

Riverside Drive Structure Restored to Level at Small Cost—Settlements of 1 to 7 Inches in Six-Pile Footings

EMPLOYING a small force of men and raising one column at a time, the Bureau of Highways of the Borough of Manhattan, New York City, has restored approximately to original level six steel columns under the Riverside Drive viaduct just north of 130th Street, the pile footings of which had settled from 1 to 7 inches. The six columns which settled are those of the first three bents north of 130th Street, and four and a half years ago, when the settlement was first noticed, the bridge department of the city proposed extending the footings at a cost of $100,000. The present work, however, has restored the viaduct substantially to its original condition for less than one-ninth of this sum, and it is considered quite possible that no further work on this account will ever be required.



LEFT, LOOKING NORTH UNDER VIADUCT AT THREE BENTS WHICH SETTLED—RIGHT, 200-TON COLUMN LOAD RAISED ON JACKS

The east columns, at right of left-hand view, settled most. Starting with column at extreme left, the column numbers and amount of settlement at each are: No. 15, ¾ in.; No. 17, 5 1/16 in.; No. 19, 4 9/16 in.; counting in the same way, beginning with column at extreme right: No. 16, 7⅛ in.; No. 18, 7 7/16 in.; No. 20, 5⅞ in.

The columns under the viaduct transmit their load through heavy steel plates to granite blocks which rest on stepped concrete footings, each founded on 16 piles driven to an approximate penetration of 60 to 70 ft. The load on each of the columns in question is approximately 200 tons. As no settlement can be detected elsewhere in the viaduct, it is considered possible that these six columns are located over a deep pocket of mud. The columns on the east side of the viaduct settled more in each case than the corresponding columns on the opposite side, which resulted in distortion of the west columns, column 16 having deflected till the center line of the column was approximately 2 in. west of the center of the base at a height of 10 ft. from the ground. The unequal settlement also caused the viaduct to lean slightly toward the east, and to some extent warped the east columns. The method by which the viaduct was restored was to raise the columns one at a time, taking first those which had settled most and putting additional steel plates between the column bases and the granite blocks on which they had rested, place cast-iron fenders around the base of each column and fill the fenders with grout.

A diaphragm built up of 4 x 5 x ⅝-in. angles and ⅝-in. plates was put in each column far enough above the base to allow the insertion of needlebeams without removing the lower tie plates. The lower pair of lacing bars on each side were then taken off and the beams put in place. Twelve 25-ton steel screw jacks, arranged on blocking, were used to raise the columns. The lateral movement of the columns necessitated resetting the jacks frequently during the work. In one instance the operation of raising column 16, which had settled 7⅛ in., restored to vertical position column 15 in the same bent, which had only settled ¾ in., but had been considerably distorted. In other cases the jacking operations did not bring the top of the structure back into perfect line, and in order to get the columns plumb the bases were driven over, while the columns rested on the jacks, by means of a 12 x 12-in. timber ram 15 ft. long suspended from a set of falls.

It was the intention to raise each column about ⅜ in. above the original grade. Levels were run for this purpose shortly before the work was started and the steel column bases raised a measured distance above the granite blocks on which they rested. However, levels taken after the last column had been raised indicated that the foundations had settled approximately ½ in. since the first readings were taken. This settlement during raising is accounted for on the theory that the footings continued to carry most of the load even during actual jacking operations, as the blocking under the jacks rested partly on the shoulders of the concrete footings below street level.

The work has been done by forces of the Bureau of Highways, Borough of Manhattan, New York City, of which Eugene W. Stern is chief engineer, under the supervision of R. A. MacGregor, assistant chief engineer.

Future of the Technical and Trade Press

An Address Before the Convention of the Associated Business Papers, Delivered in New York City, October 26, 1916

By JAMES H. McGRAW
President, McGraw Publishing Company Inc.

> MR. McGRAW'S ADDRESS *is more than a mere analysis of a publisher's opportunity. It is an analysis of industrial conditions in the United States to-day as they affect not only technical or business papers, but engineers, contractors and manufacturers. Mr. McGraw foresees for the business paper an era of greater power, and this necessarily implies a larger scope for the men whom the technical and business papers serve.*—EDITOR.

THE remarkable development of the business press during the past twenty-five years is a matter of pride to everyone engaged in this field of publication. This development is proof of the need of the business press, as well as proof of the big opportunity existing. Some may feel that, following this rapid development, will come a slower future progress, on the theory that we have scaled the greater part of the heights of opportunity, and that less lies still above us.

Existing conditions do not justify that thought or feeling. As a matter of fact, opportunities were never so great as they are to-day. Moreover, never have the business papers been so strong financially, so well organized to attack their problems.

The opportunity, however, if it is to be grasped, must be clearly seen not only by a few editors and a few publishers, but by everyone engaged in the production of business papers.

THE OPPORTUNITY

Since the European war began, our industrial problems have appeared in a new light. Specifically, there are three new factors influencing the thoughts of the country with reference to its industrial problem:

1. The situations disclosed in European industry by the war.
2. Our new attitude toward foreign trade.
3. The labor question.

The war has disclosed that Germany is remarkably well co-ordinated as an industrial nation, that the efficiency of her workers and her executives is high, that she has used to the utmost in developing her industries the agencies of scientific and engineering research. England, on the other hand, for the first time in twenty-five years, has understood thoroughly her own industrial position. Her industries are not co-ordinated, her labor efficiency is shamefully low. She has failed to avail herself of the benefit of research work.

When David Lloyd-George undertook to organize the munitions making of England, he put into factories women and girls who had never been in a shop before. Yet within a month's time these inexperienced hands were turning out double the production of the experienced workers before them. In many cases the production was treble that of the men, without fatigue or injury to the health of the women.

This disclosure has not only shocked England into new life industrially, but has caused leaders in this country to inquire whether we are in England's or in Germany's class. Furthermore, the disclosure showed why Germany was making inroads on British foreign trade, and further, that labor was responsible for the throttling of English industrial life. As a result of the munitions-making experience in England, various investigations were undertaken looking to the discovery of a solution of the difficulty. One of these investigations was a study of the possibility of British industry benefiting by scientific research.

THE LESSON FOR US

Had these conditions in Europe been disclosed twenty years ago they would have been sufficiently interesting to stir us to very active thought. But if that would have been true twenty years ago it is far more true to-day. Twenty years ago we were largely self-sufficient in the sense that until then our own development internally had been so rapid as to absorb most of the products of our labor, except surplus food stuffs. Now competition is keener. Now there is a surplus of manufactured products. Not only do we need foreign trade as an outlet for the work of our people, but business men generally realize that a goodly percentage of foreign trade is a remarkable stabilizer. Competent authorities say that every business should export one-third of its production. In this way conditions in all quarters of the globe would be hooked up with our own, and good times elsewhere would help to mitigate conditions when we had relatively hard times here.

But if we are to develop a large foreign trade, must we be in England's or in Germany's class, with reference to our industrial organization? England's own experience in the past quarter century sufficiently answers the question.

SOME OF OUR LEADERS AWAKE

It is apparent that some of our leaders realize how serious our industrial situation is, how great the similarity to England's rather than to Germany's. Within the last year the industrial preparedness committee of the Naval Consulting Board has made an industrial census of the country in order to co-ordinate our industries with the defense machinery of the country. That is a long step forward in industrial co-ordination, even though its chief mission is a military one. There is bound to flow from it, too, benefits in times of peace, because there will necessarily be interchange of ideas, through government agency, regarding production methods, accounting, etc.

The Federal Trade Commission is another indication that we realize that a new era has come into our industrial life.

A third factor is the organization of the National Research Council, which aims to bring together the scientific and engineering brains of the entire country in order that the products of research may be woven into our entire industrial fabric. Germany has won primarily because of her research work and the way it has been tied up to her manufacturing operations. On our own National Research Council will be represented every phase of scientific and engineering endeavor, so that no possible agency which can help us in an industrial way will be overlooked.

THE LABOR QUESTION

The third factor which is causing us to think anew, and seriously, regarding our industrial situation is the demonstration of the power of labor at Washington in September. It is too fresh in mind to be rehearsed in detail. He who thinks that the victory of the railroad brotherhood is an isolated event is blind to the labor movement that is developing in this country. It is part of a great whole. It is notice to the country that unless our industrial leaders "beat labor to it" by proposing and putting into effect the correct solution of the labor problem, labor itself will force a solution. That solution will be to labor's own liking, and the welfare of industry and of our national life will have no consideration in the deliberation and conclusion.

WHAT IS ITS SIGNIFICANCE TO THE BUSINESS PRESS?

What does this mean to the business press? The business press is the representative of industry. It should be the leader in devising ways and means of industrial co-ordination. It should set the necessary broad-gage policy toward labor.

If the business press does not do these things—help to raise the efficiency of industry, help to co-ordinate as Germany is co-ordinated—it will not merely lose an opportunity; it will be signing its own death warrant. Already the newspapers of the country have declared that the business press is a more or less useless activity; that the newspapers of the country can adequately and fully serve the business man.

The day of muckraking has passed. The salacious story does not attract even morbid interest on the part of the public compared with a little time ago. During all the period of muckraking and salacious stories on the part of newspapers and magazines the business papers have stood for constructive effort. It should be the first concern of the business press to make this idea known to the industrial world. Magazines and newspapers are becoming more and more a part of the business of the country. They see that their own prosperity is bound up with the prosperity of the nation.

If, however, the business-press publishers will fully realize the import of what is now going on, will decide broadly what policy is proper, and will bend every endeavor toward avoiding the crash that is otherwise inevitable by getting industrial leaders to accept this broad and sound solution, they need have no fear that the wish of the newspapers will be realized.

IN THE CENTER OF ITS FIELD

In order that the business paper may exercise this broad and beneficent influence it must be in the center of its field. Its position must be such that no important move will be made without the paper being in the inner council. The paper can perform two functions:

1. With its grasp of the field, it can gage the reception a proposed step will receive. Moreover, because of its semi-detachment, it is able to estimate the effect of a policy better than those who see the business from only one angle.

2. With its knowledge of the psychology of the field, and its knowledge of publicity, the paper can best advise as to the way the most can be made out of a certain bit of information, the announcement of a new movement or policy.

Nor is it sufficient for the editor to get the data second-hand. He must know not only the outstanding facts, but the entire background. Knowing the whole situation fully, few men are better qualified than the editors of the business press to counsel and advise the leaders of an industry.

THE EDITOR MUST BE BROAD

Manifestly this gives high position to the editors of a business journal. The corollary of that proposition is that the editor himself must be a man of broad caliber, large enough in his views, firm enough in his convictions, able enough to command the respect of the leaders in his field.

With editors of the right caliber, with a broad policy, fundamentally right, which takes account of all the factors in our industrial situation, which sees into the future, which avails itself not only of all of our own experience, but that of England and of Germany, the business press will make for itself a place in our national life impossible of attainment by any other medium, or possibly any other agency. If we have but the foresight and the ability, we shall be the main directors of the industrial and commercial policy of this nation. The opportunity is there, the situation is a pressing one at the present minute. What is needed is an adequate grasp of the situation by our business publishers and a persistent, firm determination to play our part in the great game in a big way for the benefit of all that is best in our national life.

Gage Measures Rail Wear on Sharp Curves

Simple Device Proves Useful in Helping Get Maximum Service from Short-Lived Rails Without Overstepping Safety

By J. T. BOWSER

Maintenance of Way Department, Queen & Crescent Route, Danville, Ky.

THE comparatively long life of rail on tangents, the character of the wear and the conditions which must be considered when determining the necessity of renewal rarely make it possible for such rail to be retained in the track long enough for the wear to pass the point of safety. The economical maintenance of track usually requires the renewal of such rail before the wear becomes so great. On the sharper curves, however, the life of rail is rarely longer than one year, and under very heavy traffic is sometimes only a few months. The nature of the wear of rail on curves is essentially different from that on tangents, so that the safety point of wear may be easily passed long before the economical maintenance of track may require renewal. But while there must be an ample margin of safety allowed, the extremely short life of rail on curves makes it doubly necessary that the maximum safe service be obtained. Some sort is desirable to see that this maximum is not exceeded.

CAREFUL INSPECTION NECESSARY

In order that the requirements of both safety and maximum wear may be obtained, frequent and careful inspection is absolutely necessary, and on railroads having a large number of curves these frequent inspections cannot usually be made by the higher officials of the maintenance-of-way department who would ordinarily make the inspections of rail and recommend renewals. This duty then devolves on the minor officials—the track supervisors, etc.; and since the individual judgment of these men may vary so widely, it is quite likely that rail will be left in the track after the wear has passed the margin of safety, or that in some instances it will be removed before it has given the maximum safe service. It is therefore obvious that to obtain both safety and economy some definite standard must be adopted as the maximum permissible wear, and some means provided by which the wear may be accurately measured.

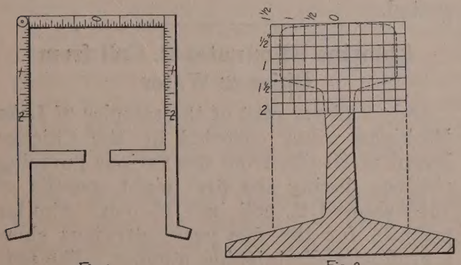


Fig. 1 Fig. 2

RAIL GAGE AND DIAGRAM FOR RECORDING WEAR OF RAIL

THE GAGE AND ITS USE

Fig. 1 represents a gage which may be effectively used in measuring flange wear. The graduations on this gage, it will be seen, readily permit measurements to be taken, from which the cross-section of the rail may be plotted. Fig. 2 shows a drawing on which the cross-section of the rail may be plotted if a report of the conditions found is required. This drawing will be found especially useful in determining the maximum allowable wear if a standard has not already been set for this.

If such reports are not required and a standard for wear has already been adopted, then it is only necessary to obtain by means of the gage the measurements at predetermined points on the graduation and check these against the measurements at similar points on the standard, and the approach to the maximum wear is determined.

It is, of course, hardly possible for anyone to fix absolutely the point at which the wear of rail passes the margin of safety, but on rails of A. S. C. E. section (on which the drawing in Fig. 2 is based) it is very probable that this point will be reached when the center of the arc of the curve on the inside of the ball passes the plane of the inside of the web produced.

Portable Plant Makes Bituminous-Pavement Patches

Recent Street-Repair Work in Charlotte, N. C., Cost 60 Cents per Square Yard—Wood Preferred to Coal for Heating

By SAMUEL H. LEA

City Engineer, Charlotte, N. C.

FOR making patches in bituminous pavements the portable repair plant shown in the accompanying illustration has been adopted in Charlotte, N. C. The city has about 30 miles of bituminous pavement, comprising an area of 485,000 sq. ft. The older pavements have gone out of guarantee and the burden of maintenance of quite a large area of bituminous pavements rests upon the city.

The writer has devoted much time and thought to the matter of paving repairs, and different methods have been tried, including cold patching. A home-made heating kettle was used, but after performing useful service it was discarded for the portable repair plant shown in the picture. The complete outfit comprises one Hooke portable asphalt repair plant, one mule and wagon, three laborers, tools and appliances.

PORTABLE PLANT FOR BITUMINOUS-PAVEMENT REPAIRS IN CHARLOTTE, N. C.

PLANT DETAILS

The asphalt repair plant consists of a portable heater with a pan of about 21 cu. ft. capacity. The firebox is at the rear end and the asphalt kettle at the front end. The following tools are used with this outfit: Two shovels, 2 rakes, 1 potato hook, 2 smoothers, 2 iron tampers, 3 galvanized iron buckets, 2 asphalt axes, 2 stable brooms, 1 pick and 1 house broom.

The asphalt mixture used in making the patches is of about the following proportions: Sand, 75 per cent; Portland cement, 10 per cent; asphalt, 15 per cent. A batch of the mixture is composed of the following ingredients: Sand, 16 cu. ft.; Portland cement, 2 sacks; asphalt, 190 lb.

In operation the pan is charged with sand and the asphalt is placed in the kettle at the front end. Fire is made in the firebox and the sand is heated until thoroughly dry. In the meantime the asphalt is being melted in the kettle. Dry pine is used for fuel. This is more satisfactory than coal, although the latter may be used.

After the sand has been sufficiently heated, two sacks of cement are added and well mixed with the sand by the workmen, who stand on running boards at the side of the pan. After thorough mixing dry, the melted asphalt is poured into the pan. The whole mass is then thoroughly mixed until all the grains of sand are coated and the mixture appears black throughout.

The holes to be repaired are made ready by having the edges carefully trimmed with an asphalt axe, leaving the sides of the cut vertical. The bottom and edges are painted with the melted asphalt to insure a bond between old and new material. The hot pavement mixture is applied in a single layer of such thickness that, when thoroughly compressed with the tamper and finished with the smoother, the surface will be uniform with the surrounding pavement. After the new work has been finished with the smoother a small quantity of Portland cement is applied to the surface and the surplus swept off with a broom, leaving just enough to show the cement color.

COST

The actual cost of work recently done with this plant is as follows, one day's work comprising a number of widely scattered patches:

COST OF PATCHES IN BITUMINOUS PAVEMENTS

36 cu. ft. of screened sand	$1.20
4½ sacks of Portland cement	2.58
450 lb. of asphalt, 60 to 65 penetration	4.95
One-horse team	2.00
3 laborers	3.75
Fuel	.72
Depreciation, etc.	.50
Total	$15.70

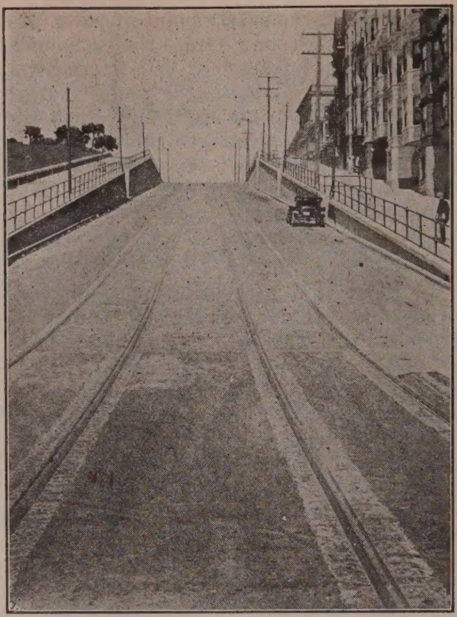
Area covered by patches, 26 sq. yd.
Unit cost, $0.604 per square yard.

Heavy Street Grades Cut Down in San Francisco

One Intersection Lowered 14 Feet—Switchback Scheme Resorted To to Reduce a 20-Per Cent Grade

TO make certain sections of San Francisco more accessible, street regrading has lately been undertaken at many points where it was feasible to make the change at low cost. No standard plan has been adopted, a study being made of each case independently. In fact, with grades ranging up to 55 per cent, a wide variety of remedial measures is required.

In the Hayes Street regrade, shown in the accompanying illustration, it was found feasible to cut the roadway down between curb lines for a maximum of 15 ft., thereby establishing a 10.909-per cent grade instead of the 14.54-per cent grade previously existing. This involved lowering one street intersection an average of 14 ft. Retaining walls were built at the curb lines to form the sides of the cuts, and stairways were provided at intervals connecting the street with the sidewalks at the upper level. Sewers and public-utility conduits were placed under the sidewalks.


ON HAYES STREET A 15-FOOT CUT REDUCED THE GRADE 3.5 PER CENT

Formerly the electric-car line made a detour at this point to reach the district beyond. Since the regrade the car line continues directly over the hill through the cut, this effecting a considerable saving in time and power. On this work 11,500 cu. yd. of excavation was made by the street-railway company and the city paid $16,000 for the remainder of the improvement.

REDUCE 20-PER CENT GRADE

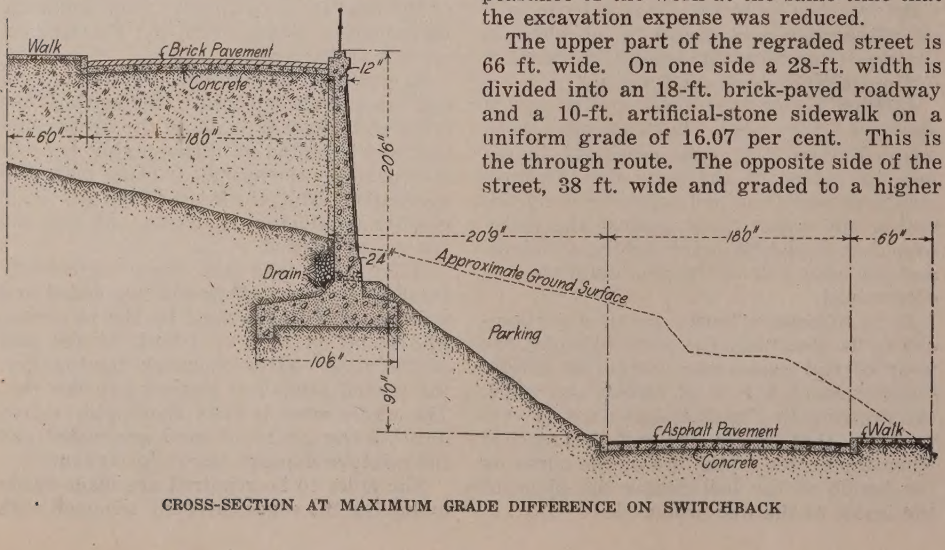
In another case property owners in a residence district applied for a regrade on two blocks on which the grade was reduced from 20 per cent to a maximum of 16 per cent. Here it was found desirable to provide an indirect route, so the roadway went west a few hundred feet on half-street width and then returned east on the opposite half of the street, the two grades being separated by a reinforced-concrete retaining wall. After gaining a rise of about 30 ft. by this method the roadway makes a right-angled turn into another street, where a continuation of the same grade brings the roadway to the next crossing without doubling back. It was, however, found desirable to divide the street at the upper end into two grades, separated by a retaining wall as before. This gave convenient access to residences on the upper end of the regrade over an easier gradient than the through route and secured a much better general appearance of the work at the same time that the excavation expense was reduced.

The upper part of the regraded street is 66 ft. wide. On one side a 28-ft. width is divided into an 18-ft. brick-paved roadway and a 10-ft. artificial-stone sidewalk on a uniform grade of 16.07 per cent. This is the through route. The opposite side of the street, 38 ft. wide and graded to a higher elevation, has grades varying from 4.37 to 10.92 per cent. A 28-ft. width is paved for vehicles. The sidewalk for the through route follows this higher level and descends a drop of about 30 ft. across the "switchback" by a series of stairs located where the crossing is most convenient.

COST OF IMPROVEMENT

The cost of this improvement was paid entirely by the owners of property fronting on the two streets affected by the regrade. On one street the assessment was $16.31 per front foot and on the other $20.29 per front foot. The property values were about $115 per front foot before the change and are now rated at about $250 per front foot. The total cost of this work was approximately $30,000.

The work is handled entirely by the engineering department of the city under the direction of M. M. O'Shaughnessy, city engineer.



CROSS-SECTION AT MAXIMUM GRADE DIFFERENCE ON SWITCHBACK

Old Roads Maintained with Roller and Scarifier

Cost of Keeping Up Macadam Highways in Putnam County, Indiana, with Simple Power Equipment

By GEORGE E. MARTIN
Assistant Professor of Highway Engineering, Purdue University, Lafayette, Ind.

PUTNAM COUNTY, Indiana, has a very large mileage of macadam roads. Many of these roads were built with but little attention to grades or drainage. Greencastle, the county seat, is in the center of a region producing a good grade of road-building limestone, and comparatively large amounts of stone have been placed on the roads of the vicinity.

Last year the county purchased a steam roller with a scarifier attached to it. This outfit has been used to dress up the roads at the following costs for operation:

	Total cost per day	Coal cost per day	Miles operated	Days operated	Cost per mile
May	$6.56	$1.23	16.75	23.6	$9.24
June	6.69	1.54	19.50	25	8.56
July	7.25	1.35	27.75	25	6.84
August	6.43	1.85	30.25	25	5.35
Average	6.73	1.49	23.56	24.65	7.50

These costs are based on coal at $3 per ton; wages of roller operator, 30 cents per hour; wages of helper, 25 cents per hour; and teams for hauling coal, 35 cents per hour.

The roads were about 12 ft. wide. In most cases they were both graded and rolled at this cost. About 50 per cent of the mileage was scarified and 12 miles were rolled only.

The work was done under the direction of Alva E. Lisby, Putnam County road superintendent, who collected the data quoted.

Chlorine Eliminates B. Coli from Chicago Water

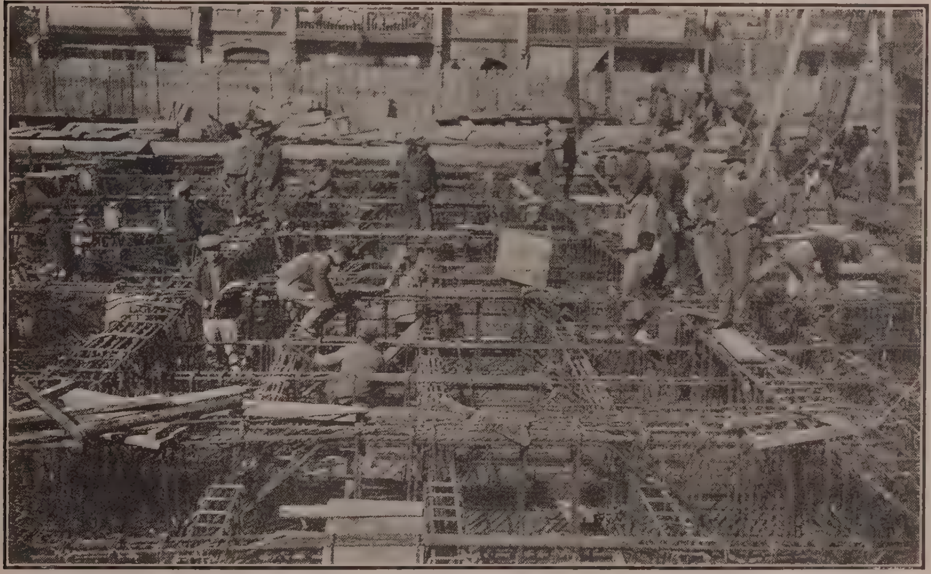
Only 0.28 per cent of the samples of Lake Michigan water collected by the Chicago Board of Health from the various pumping stations during the first eight months of 1916 showed B. coli in 1 cu. cm. Similar samples for the five years previous show a gradually diminishing number. The percentages are 18.1, 11.3, 5.3, 4.5 and 2.7 per cent in 1915.

Chinese Build Reinforced-Concrete Warehouses

Mixing Done on Floor Being Poured—20,000 Square Feet in Month Good Progress—Design Dispenses with Mechanical Equipment

By E. PARK
Formerly Assistant Engineer, Chinese Government Railways

REINFORCED-CONCRETE building construction is gaining favor in China, and a number of warehouses of this type, of considerable size and weight, have been built in Shanghai and other trade centers. The building of the Chinese government railway has furnished a good school in construction work for Chinese contractors, and there are a number now in business able to undertake any sort of building construction and perform it with skill. Although electric power is available in several cities, mechanical construction plant is practically unknown, being unable to compete in cost with human labor.



DIFFICULT JOB OF PLACING STEEL FOR HEAVY MAT FAULTLESSLY EXECUTED BY CHINESE

HUMAN CONVEYORS USE STAIRWAYS

The photograph shows construction in progress on a group of warehouses four and five stories high at Hankau. The floors are of the beam-and-girder type; the columns are square. One building is floated on a heavily reinforced concrete mat, the construction of which was faultlessly executed by the Chinese contractor.

The most noticeable feature of the design of these buildings is the absence of elevators and of any mechanical conveying equipment. The upper floors are reached by external stairways with steps having 11-in. treads and 4½-in. risers. Everything is carried from warehouse to warehouse or from warehouse to ship by coolies. Several hundred of them moving in long lines carry the heavy bags of goods, and form a most effective conveyor. It is economical to carry bags weighing 192 lb. to floors 70 or 80 ft. above the ground in this way.

In constructing these warehouses the stone, sand and cement used were carried separately almost to the point of concreting and mixed on board platforms resting on the reinforcing steel. The concreting of a single floor slab 100 x 200 ft. will keep the contractor busy for two weeks or more, and little effort is made to strip forms and reerect them for the next floor until the one on which the work is in progress has been completed. Perhaps this is because labor of all sorts is plentiful, and there are no union carpenter organizations whose members must be kept busy continuously if the contractor is to hold enough of them to finish his job.

FORMWORK HEAVY

The tendency as yet seems to be to make the formwork heavier than necessary, the contractor for one of these buildings having used 3-in. Oregon fir for lagging, even after the engineer had told him that it was far heavier than was required. Chinese fir is used to some extent for forms, though the wood behaves something like hemlock and cannot be used for exposed surfaces where good appearance is necessary. The Chinese carpenters are good workmen, and the centering is well fitted and accurately placed.

The same may be said of the reinforcing, most of which in the buildings mentioned was secured together with wires. An idea of the care with which this work was done may be gained from the photograph of the reinforcing for the concrete mat under one of the warehouses. This steel was all bent on the job by hand, using home-made benders.

In the erection of exterior trim the Chinese, having a plentiful supply of bamboo for scaffolds, possess a considerable advantage over American contractors. All of their scaffold work is lashed.

The contract price of reinforced-concrete work of this class in Hankau was about 50 taels per 100 cu. ft., including cement, sand, stone, labor and formwork, but not the reinforcing material. This corresponds to about $9.45 per cu. yd. Although this may be high in view of the low cost of labor, it must be remembered that Oregon fir in China costs more than $40 per thousand and that cement is at least as expensive as elsewhere.

The writer has never seen in use in China a concrete mixer, buggies, chutes, hoists or any other mechanical equipment for handling concrete. The freight on tools of this sort makes their cost very high, and they cannot compete with hand labor even where electric power is available, as at Hankau.

Makes Cost Comparison of Sewage Treatment

Harrison P. Eddy Gives Data on Activated Sludge Versus Imhoff Tank-Trickling Filters Plant for Fitchburg

INITIAL costs of an activated-sludge plant are less per capita and per 1,000,000 gal. than the Imhoff tank-trickling filter method, but the operating expenses are so much higher that the balance is distinctly in favor of the latter method. This was the conclusion reached by Harrison P. Eddy, consulting engineer, Boston, in a paper presented Oct. 16 to the Western Society of Engineers. Other considerations, such as available space, less chance of nuisance and future reductions in operating costs (he figured power at 1 cent per kilowatt-hour), may make the activated-sludge method a closer competitor under changed conditions.

COMPARATIVE DATA

The 5,500,000-gal. Fitchburg plant was taken for comparison purposes. It was built to serve 55,000 persons, although at present only 32,500 persons are connected with the system. On the basis of 55,000 persons the older method cost $7.85 per capita and the 1,000,000-gal. cost was $78,500. Corresponding figures for an activated-sludge plant were given as $5.71 and $57,100. The estimated annual costs of a typical Imhoff tank-trickling filter plant are $8.50 per 1,000,000 gal. treated and 31 cents per capita. For the activated sludge the costs are $20 and 73 cents respectively. Figuring interest at 4 per cent and a depreciation sinking fund at 2½ per cent, the total annual costs are $21.84 and $29.85 per 1,000,000 gal. for the trickling filters and activated-sludge plant respectively. Per capita the corresponding costs are 80 cents and $1.09. Adding the capitalized expenses at 4 per cent to construction costs the difference in favor of the trickling filter plant is $284,170.

SLUDGE USED ON PLANT GROUNDS

With reference to the disposal of sludge of the Fitchburg plant, now in operation two years, Mr. Eddy stated that there had been a number of applications from farmers to haul it away, but that the surrounding grounds of the plant were so much in need of enrichment it will be several years before any outside means of disposal will be sought. The operation of lifting the sludge by means of an air pipe simply tapped into the side of the vertical sludge-removal pipe has worked out satisfactorily. Contrary to expectations, the air does not collect in large volume behind a solid mass of sludge, but mixes with it in fairly small globules. The flow can easily be regulated to deliver an even stream without any spurting.

To Divert Lincoln Highway from Nevada "Mud Flats"

A way has been found to bypass the Lincoln Highway away from the famous "mud flats" in central Nevada, the improvement for which Eastern donations have been made recently. The proposed change will carry the road north from the present right-of-way over what is known as the Stillwater cutoff, 30 miles east of Fallon on the Carson Sink. While no longer than the existing route, it will provide a more scenic drive on high ground.

General Track and Building Plan for Chicago Union Station Is Made Public

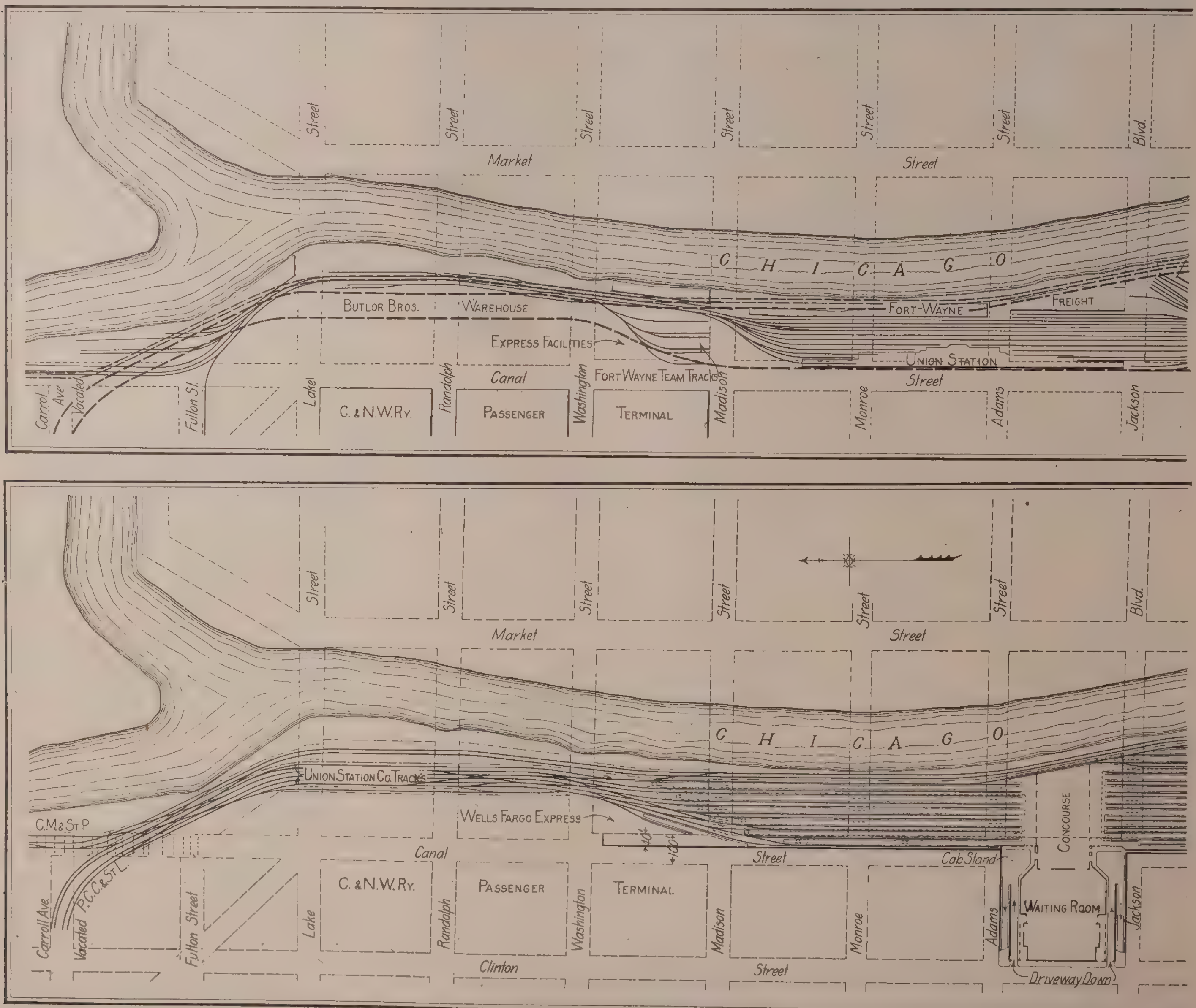
Stub Tracks Will Run Each Way from Concourse Between Adams Street and Jackson Boulevard—All Facilities for Traveling Public on One Level

A MAIN station building west of Canal Street, leaving the entire space between Canal Street and the Chicago River free for tracks and mail and express facilities; a passenger concourse running across from the main building nearly to the river, two sets of stub tracks, one running north and one south from the concourse, and three through tracks along the river for interchange purposes—these are the essential features of the general plan for the Chicago Union Station, adopted in July and now made public. The station building will occupy the entire block bounded by Clinton, Adams and Canal Streets and Jackson Boulevard. Some of the platforms will run north beyond Madison Street and south nearly to Harrison Street, giving an overall length of 2900 ft. A basic idea of the development was that of providing all of the facilities for serving the public on one level, and this will be accomplished by sinking the general waiting room and concourse to the platform level. Features of the improvement include high platforms and a system of longitudinal and diagonal baggage tunnels reaching the far end of each platform. Incidental to the improvement are the relocation of extensive freight facilities to make room for the expanded track layout. The broken profile of Canal Street will also be greatly improved, and the street will be widened from 80 to 100 ft. The adjustment of cross-streets and reconstruction of viaducts to the new profile and the reconstruction of sewers are of scarcely less importance.

OLD STATION OUTGROWN

The old Union Station, which has been far outgrown by the traffic, was built about 1880. Until acquired by the new Union Station Company it was owned by the Pittsburgh, Fort Wayne & Chicago Railway (Fort Wayne) of the Pennsylvania Lines West of Pittsburgh. It was and is used jointly by that company, the Chicago & Alton, the Chicago, Burlington & Quincy, the Chicago, Milwaukee & St. Paul and the Pittsburgh, Chicago, Cincinnati & St. Louis (Panhandle) of the Pennsylvania system, the other four roads being tenants on long-term leases. The main building is located on the east side of Canal Street north of Adams Street. The tracks occupy a strip of ground less than 100 ft. wide, extending from Madison Street on the north to about Van Buren Street on the south. The Fort Wayne, Alton and Burlington enter from the south over a four-track line located on property formerly owned jointly by the Fort Wayne and the Alton. The Panhandle and the St. Paul enter from the north on a two-track line owned jointly by the Fort Wayne, the St. Paul and the Chicago & North Western. The station is a combination through and stub type, but the through tracks are so short that long trains frequently occupy the full length of the tracks both north and south of the axis of the station, and consequently the capacity of the station is greatly limited.

While the station has been badly overcrowded and congested for many years, it was so surrounded by freight terminals as to make expansion of the present site impossible without extensive readjustment of



LAYOUTS OF OLD AND NEW CHICAGO UNION STATION, OLD ABOVE, NEW BELOW—OUTLINES OF MAIN UNITS OF NEW LAYOUT SHOWN ON the freight terminals; and on the other hand the companies using the station did not care to surrender a site so convenient to the business center of the city for one less restricted but farther away. Readers of the technical press are probably familiar in a general way with the negotiations, extending over a number of years, to remedy the situation, these negotiations culminating in the Union Station ordinance passed March 3, 1914. Since then the Union Station Company has been formed, the necessary exchanges of land between the individual companies and the new company have been made, much additional land has been acquired, a large freight terminal for the Pennsylvania lines has been brought nearly to completion and a considerable amount of the underground street work has been done. Nothing has as yet been done on the station proper, as it was only last July, as previously stated, that the general plan was adopted, and the architectural design of the station, as well as many details of the whole terminal, are yet to be worked out.

RELATIVE SIZE OF OLD AND NEW LAYOUTS

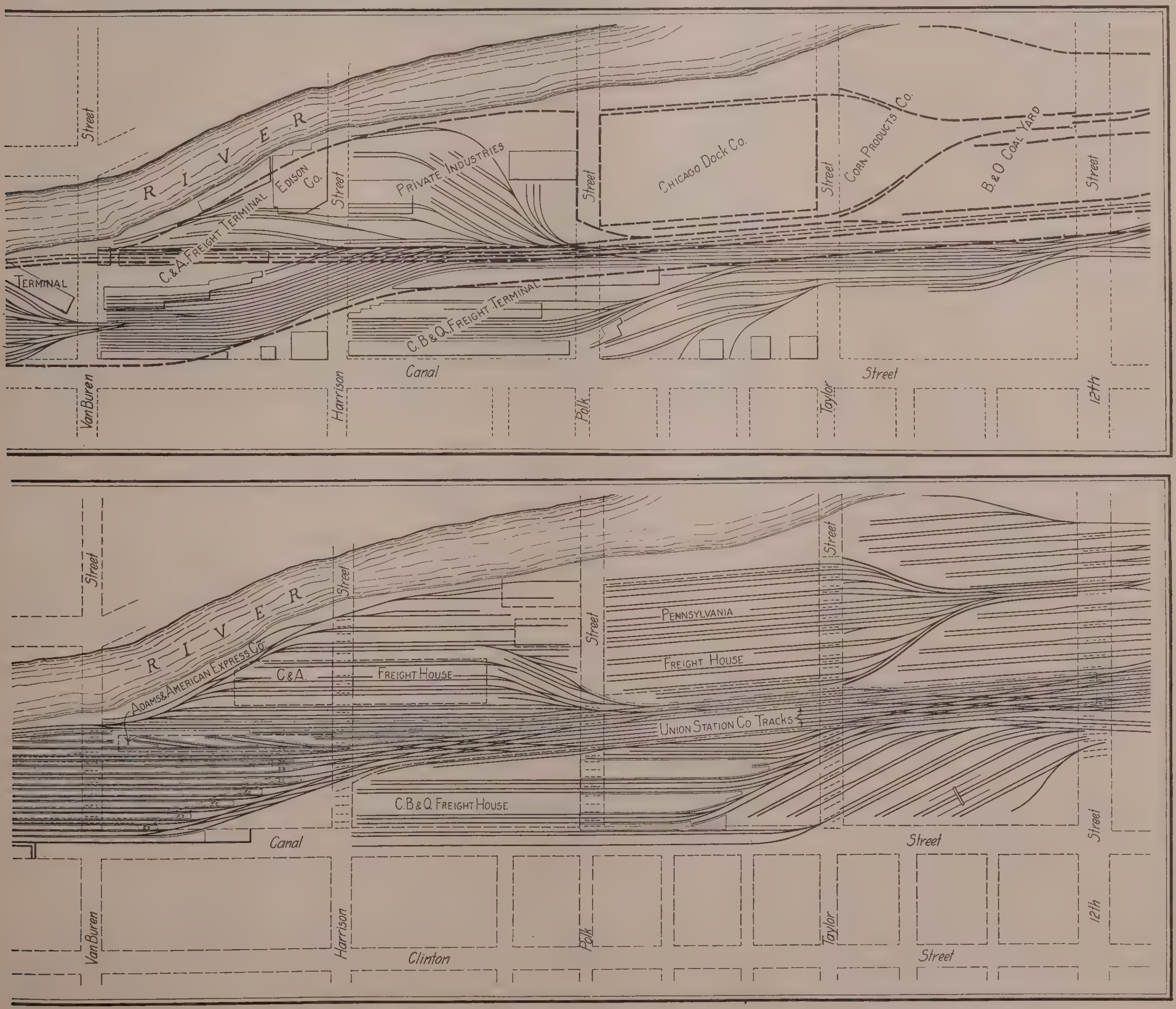
The accompanying plan of the old facilities, with the outlines of the new superimposed thereon, gives a good idea of the relative size of the old and the new layouts. More will be said later of the freight facilities displaced by the new station and its approach tracks. Suffice it to say here that the new layout occupies the entire space between Canal Street and the Chicago River from Madison Street to Harrison Street, with the exception of two runaround tracks along the waterfront, and in addition will occupy widened rights-of-way north and south of these respective limits.

The removal of the station building to the west side of Canal Street, together with the removal of the Fort Wayne freight house along the river opposite the present station, gives room for the eleven tracks needed by the Panhandle and the St. Paul in the north unit of the station; while space for the fifteen tracks required for the Fort Wayne, Burlington and Alton is attained by moving the headhouse a block to the south and taking advantage of the bend in the river to the east. An additional width is attained by carrying the tracks under 40 ft. of the width of Canal Street.

The main-floor level of the station and concourse is El. 9 above city datum, or about 17 ft. below the level of Canal and the east-and-west streets. The main entrance to the station will be on Canal Street, but entrances will also be provided on each of the other streets. The entrances to the concourse from the streets will be at the four corners; that is, two on Canal Street and two near the river. Cabs and other vehicles will reach the station level by two ramps running down as shown on the plan from Clinton Street to stands at the northeast and southeast corners. These ramps will turn on themselves and continue down to the baggage room, which will be under the main floor and also extend under the concourse.

TWO SETS OF STUB TRACKS

In the north section of the station there will be nine passenger tracks having a combined capacity length of 10,070 ft., two mail tracks with a capacity length of 1450 ft., and two express tracks with a capacity of eleven cars. In the south unit there will be thirteen passenger tracks with a combined capacity length of 15,065 ft., two mail tracks provided with crossovers so that a few cars can be switched without disturbing the entire track, and eight stub tracks having a capacity of from two to twelve cars each for the express companies. The station tracks will be alternately on 13 and 27-ft. centers, giving platforms 16 ft. 3 in. wide. These platforms will be level with the car floors, being the first high plat-



OLD IN HEAVY DASHES—NEW PASSENGER TRACKS DISPLACE FREIGHT TERMINALS, WHICH IN TURN CROWD OUT FOREIGN FACILITIES forms to be used in any Western terminal. They will be of reinforced-concrete slab construction, and the space under them will be utilized for piping and other station necessities. One of the south platforms will be 680 ft. long. The other platforms in both yards will vary in length from 800 to 1400 ft.

Each yard will be reached by six approach tracks instead of the smaller number now available. As the plan shows, two ladders will serve the north yard and three the south, and the numerous crossovers and slip switches are expected to give the desired flexibility of operation. With the exception of a few specials all turnouts and slips will be standard No. 8s.

Elaborate Baggage Tunnel System

A feature of the layout is the system of baggage tunnels. A longitudinal tunnel along each side of each yard, with diagonal tunnels connecting the far ends as shown, and elevators from the diagonal tunnels to each platform provide access to each platform for baggage trucks at two points.

The general plan contemplates two express buildings, one for the use of the Adams Express Company and the American Express Company, serving the Pennsylvania, Burlington and Alton; the other for the use of the Wells Fargo Express Company, serving the St. Paul. The former building will be located south of Van Buren Street and east of the station tracks and will be a two-story structure about 56 ft. wide, extending from Van Buren to Harrison Street, served by a driveway 40 ft. wide for the full length of the building. The Wells Fargo building will be located facing Canal Street between Washington and Madison Streets.

Unballasted Track in Station

A concrete track construction for the station tracks is to be used, the rails resting on tie plates and felt pads, fastened to 7 x 9-in. by 2-ft. 6-in. creosoted blocks by screw spikes. The blocks will be embedded in concrete and will rest on a reinforced-concrete base, with provision for drainage in the center of the track. The ladder and approach tracks will be of ballasted construction.

The tenant companies are taking advantage of the crowding out of their freight facilities by the Union Station layout by constructing larger and more modern terminal plants. Along the river between Madison and Harrison Streets three freight houses of the Fort Wayne and two of the Alton had to give way to the passenger development. The Alton is removing a third and building a new plant partly on the ground it retains north of Harrison Street and partly on new ground acquired south of that street.

The Pennsylvania found it necessary to seek a new site. Land was acquired for a new terminal between Jefferson Street and Des Plaines Street, south of Van Buren Street, with an elevated connection to the main line. This plan was vigorously opposed by business interests of the city, and was therefore abandoned in favor of the Polk Street site. The mammoth terminal is located between the Union Station tracks and the river, south of Polk Street. The site for this had to be acquired, mainly from the Chicago Dock Company and the Baltimore & Ohio. On the land of the former were tracks and large warehouses. On that of the latter were an engine house, coach yard and coal yard, which had in turn to be relocated farther from the Baltimore & Ohio terminal. The new Pennsylvania freight terminal will serve both the Fort Wayne and the Panhandle.

The Burlington was also obliged to surrender some of the land occupied by its freight terminal, west of the main tracks and south of Harrison Street. It also will reconstruct its terminal on a much larger scale.

Much Work for the City

Aside from the work on the freight terminals, most of the actual construction that has been done thus far is on the work for the city. The stipulations of the ordinance include the raising of Canal Street to a smooth profile; the widening of this street from 80 to 100 ft.; the elevation of the street to carry it over the Panhandle tracks at Carroll Avenue, the grade crossing on the low level being at the same time retained; the reconstruction of all east-and-west viaducts across the tracks, which are now at various elevations, most of them narrowing down also from the full width of the street, and the reconstruction of all sewers emptying into the Chicago River within the limits of the improvement. These sewers will be intersected by a sewer on the west side of Canal Street, emptying into the river at Washington Street and at Harrison Street. Most of the work done to date is the underground work.

Equal parts of the stock of the new Chicago Union Station Company are held by the Pennsylvania Company, the Pittsburgh, Cincinnati, Chicago & St. Louis Railway, the Chicago, Burlington & Quincy Railroad and the Chicago, Milwaukee & St. Paul Railway. The Chicago & Alton Railroad will be a tenant. The total estimated cost of the improvement is $47,000,000, of which about $32,000,000 is for land. Thus the estimated cost of construction is $15,000,000, and of this $4,500,000 is for the city's improvements, such as viaducts, street changes and property damages, leaving $10,500,000 for strictly railroad facilities.

The design and construction of the terminal are under the direction of Thomas Rodd, chief engineer of the Union Station Company, with office at Pittsburgh. J. D'Esposito, assistant chief engineer, is in direct charge at Chicago. Graham, Burnham & Company, of Chicago, are the architects for the station building.

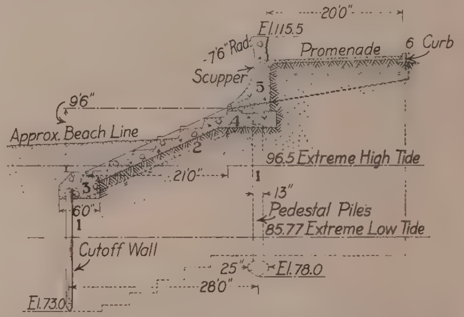
City Engineering Department Forms Engineering-Library Club

Members of the city engineering department of Dallas, Tex., have formed an engineering-library club composed of 60 per cent of the office force. The dues, which are fifty cents a month, are used to buy works on engineering. Members may suggest a book to the secretary, who posts on the bulletin board the name and author of the proposed volume, with a "yes" and "no" column underneath, a vote being taken either for or against purchasing the book. The club has been organized about four months. Eighteen books have been bought. Most of them are on civil engineering, although other technical fields are covered. The books are kept in a desk in one corner of the office and may be taken without signing for them. No book may be kept out longer than overnight. The club is now considering subscribing for a number of engineering magazines.

San Francisco Will Protect Beach with Bleachers

Monolithic Concrete Type of Construction Is Designed to Preserve Wide Beach—First Section Cost $90 per Foot

THE WIDE STRETCH of sandy beach just south of the Cliff House at San Francisco has long been regarded as one of the city's valuable assets, because it affords a conveniently accessible playground on the shore of the open sea. Though this may be a scenic advantage, the fact that it is unprotected from the open sea has endangered the permanency of the beach. Winter storms carry away the sand, and last winter the action of high waves even cut the bank behind, which had hitherto remained untouched since the city was founded. Realizing how much damage a continuation of this erosion would cause, funds were appropriated by the city for a concrete structure to protect the beach.



CROSS-SECTION OF BLEACHERS—NUMERALS INDICATE CONSTRUCTION ORDER

Contracts were then awarded for 670 lin. ft. of monolithic construction resembling bleachers, which is designed to withstand the attacks of storms.

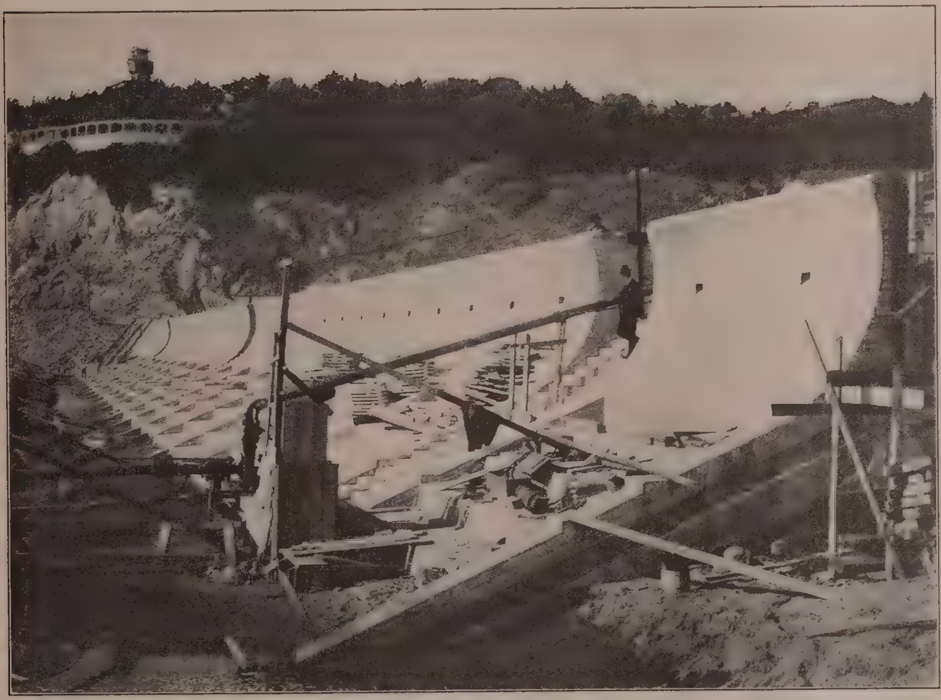
In general, the structure consists of five steps, or bleacher seats, with a minimum concrete thickness of 12 in. The seats rest on sand overlaid with 18 in. of solidly packed clay. The plane of these bleachers is inclined at about 25 deg. to the horizontal. At the bottom they rest on a cutoff wall of concrete piling extending 13 ft. below extreme low tide. Supporting the bleachers transversely at 20-ft. intervals, except at stairways, where they are on 10-ft. centers, are H-beams 20 x 43 in. in section and 27½ ft. long. These beams support the intermediate slabs by means of keyways, which served as forms when the slabs were poured. At the upper end of the inclined plane support is provided by pedestal piles 13 in. square, with pedestals 3 ft. square. These piles are 24½ ft. long and are spaced on 10-ft. centers.

Cutoff Wall of Concrete Piles

The cutoff wall at the toe of the structure consists of concrete piles, 20 ft. long and 10 in. in thickness, interlocked by steel sheet-piling connections. The sheet piling and pedestal piles were first jetted down and then the heavy H-beams were placed and supported temporarily on falsework. Forms were built in which concrete was poured so as to unite into a monolithic structure the H-beams, sheet piling and pedestal piles, reinforcing rods having been left projecting for this purpose. The slab uniting the sheet piling and the inclined plane is 4 x 6 ft. in section and carries heavy reinforcing.

After the removal of the forms from this work other forms were placed for three inclined transverse ribs in each panel, 16 x 18 in. in section, and between these the ground was leveled off and a blanket of clay solidly tamped in place so that the final slab of concrete could be poured with but slight additional formwork. The bleachers were thus formed as a slab between H-beams and the upper and lower lines of piling. After the completion of the slabs, forms were placed for a curved capital at the top of the structure, which serves the double purpose of an ornamental finish and a protection against the high waves of storms.

The mix in the sheet and pedestal piles, as well as in the H-beams, was 1:1½:3. In decks and capital the mix was 1:2:4. All the piles were precast at or near the site and allowed to season forty days before using. After the completion of the concrete work a 13,000-cu. yd. fill was scraped up from the sand and used to fill in back of the concrete to bring the level up to that of the adjacent boulevard.



THE CURVED CAPITAL WILL GIVE THE BLEACHERS A DISTINCTIVE APPEARANCE

On top of the fill, and immediately behind the capital, a 6-in. concrete paving will be placed for a width of 20 ft. This will provide a promenade and at the same time prevent any water which overtops the structure from seeping into the fill behind it and weakening the foundations. The 20-ft. pavement slopes toward the capital, through which there are scuppers at intervals. The 670 lin. ft. of the work is expected to be completed by Nov. 1, in time to protect the beach against this winter's storms.

The work is being carried out under the direction of M. M. O'Shaughnessy, city engineer, the contract for the construction being held by J. D. Hannah. The contract for the first 500 ft. was completed for a price of $89.50 per foot, but in the 170-ft. section that was added later the price was $136 per foot.

Plan Three Concrete Bridges a Year

The first reinforced-concrete bridge to be constructed in Morrow County, Oreg., was recently completed over Rhea Creek. The county has resolved to construct about three bridges of this type each year.

Is Utility Regulation on the Right Basis?

Instead of Protected Monopoly, We Need Competition—No Commission Should Be Empowered to Stop Anyone from Entering Into Any Business

By J. D. GALLOWAY
Of Galloway & Markwart, San Francisco

[*This article is commented upon in the editorial pages of this issue.*—EDITOR.]

AMID the major distractions of the time, of wars great and small, politics and other more or less important events, notice occasionally finds its way into print regarding the progress through the national legislature of certain bills for the regulation and administration of water powers subject to the control of the government at Washington. Occasionally there are meetings in some Western city of associations of men who voice their opposition to existing policies of government control of water power, and who appeal to the nation at large for relief from oppressive restrictions, interferences and domination by the bureaus at Washington. At one such recent congress held in Oregon the idea was expressed that the control of water powers should be turned over to the state government.

In order to show what relief may be obtained by transferring such control to the states it is of interest to review what has been done by the state of California, the home of hydroelectric development. In doing this, some comment is offered upon the general tendencies of the time, and as a basis for such review and comment it is necessary to examine certain fundamental principles of government and the conduct of affairs. Interference by government, whether state or national, with private individuals seeking to develop water powers for the benefit of the communities served is really a phase of a nation-wide tendency toward governmental interference with, and restriction of, all individual activity. Such a tendency, if unchecked, promises to bring to a complete stop the development of this country and to transform us from a nation with its face to the future into a people with their faces to the past. Hence engineers are interested in the subject from two standpoints, the technical one of their immediate occupation and as citizens of the nation.

TWO OPPOSING PRINCIPLES OF GOVERNMENT

In the history of the world two mutually antagonistic principles have ever manifested themselves in human affairs, and between them there is no compromise. One has in view the dominance of one selected class over the other. Taking the form of an autocracy led by a king and buttressed by ecclesiastical organizations, the selected class has claimed for itself all special privileges, has monopolized the sources of wealth and has battened itself upon the mass of the people; securing its control by restrictions, rights, privileges, monopolies and all of the thousands of methods by which the free spirit of the individual could be repressed, hampered and restrained. Opposed to this has been that principle that expresses itself in complete freedom of all individuals, that recognizes no rights of power of any kind and which holds as its chief tenet an equality of men before the law.

The pages of history are filled with the records of bloody revolutions of the peoples against the real and imaginary restrictions of their ruling classes, and the contest is still on. Under one régime the individual exists for the state, to be used as the state may direct, and to contribute to the state all of his earnings except those sufficient for existence. If examined, the state is found in this case to be a ruling class whose business it is to dominate the classes ruled. It was epitomized in the saying of Louis XIV, "L'état! c'est moi." Under the opposing plan, the state exists for the individual and is limited to certain definite functions, such as securing equality of opportunity, protection of property and the administration of justice. Free to exercise his native abilities in any direction consistent with the rights of his neighbors, the normal individual may pass his lifetime without coming into any contact with the government, whose activities are reduced to an extreme minimum.

This latter has been the American plan, and under it the Americans have developed their land unrestrained by the trammels of an arbitrary and restricting government.

In doing this they have developed under private initiative an efficiency of construction and administration undreamed of by any other nation, ancient or modern.

DEFECTS OF INDIVIDUALISM

It is not to be supposed that any form of human organization is without defects. The unrestrained individualism of America has placed power and wealth in the hands of men who have immediately endeavored to secure to themselves the privilege of power by instituting monopolies, by securing control of the government and by usurping its functions, even as an aristocracy does.

This result of unrestrained individualism becomes immediately antagonistic to the individual, and hence any aggregation of men who attempt to monopolize any source of wealth or to secure to themselves any of the functions of government becomes thereby opposed to the interests of the individual. They are thus subject to all the criticism advanced against any ruling class, whether it be aristocratic, ecclesiastical or financial.

GROWTH AND DEFECTS OF REGULATION

In many states, and also in the national government, the exercise of arbitrary power by corporations, together with the concomitant corruption of all the functions of the state which usually go with arbitrary power, led or is leading to political revolt. In California an upheaval took place some years ago which had the effect of largely eliminating corrupt influences from the politics of the state and of placing a group of honest and capable men in charge of affairs. The gradual elimination of such influences from the national government is known to all.

It is, however, a good illustration of the inconsistency of the works of men that many, if not all, of the efforts of those whose business it was to reform abuses have brought about, or are seeking to bring about, conditions that effectually perpetuate the abuses of the past and which more and more restrain, hamper and discourage that private initiative which has created this country. Yielding to that demand for a state guarantee of any monopoly which comes from those who enjoy the fruits of the monopoly, or in a futile attempt to control existing monopolies, state commissions of all kinds have been formed. State commissions in California control the actions of your barber or dictate where you shall hunt or fish. In California a commission has control of all waters above the ground or under it. The State Railroad Commission is apparently unlimited in its control over all forms of corporate or individual activities which relate to that elastic term, the public service. More and more commissions are proposed, such as one to regulate and control the sale of the products of the soil. Such tendencies grow by what they feed upon, and under this extension of powers of government the individual disappears.

Several bad results flow from the development of the functions of the state. Its immediate effect is to hamper and restrain the individual. With our rapidly increasing population it is becoming more and more difficult for any individual to make his way or give scope to his talents. The way should be cleared of every obstacle it is possible to eliminate from the path of native ability. Yet the formation of state commissions, with rules, regulations, fees, hearings, examinations, reports and all their attendant functions, serves only to restrain and obstruct the normal man, for whom there are already a sufficient number of obstacles. No matter how much any government might ever reduce its functions, it could never act as other than a deterrent upon individual initiative.

CERTIFICATES OF MONOPOLY

The most important result of the activities of government commissions is, however, the virtual confirmation by the state of existing corporations, thus making them monopolies. Going beyond the usual restrictions, the California Railroad Commission has, in the case of hydroelectric companies, taken the stand that it may debar any given corporation from a designated territory. This it has done, in at least one case. The net result has been that those corporations which existed at the time of the formation of the commission have practically received a state certificate of monopoly, and that over most of the state no new corporation can be formed to develop its abundant water powers.

The plea is made that this is done for the benefit of society in reducing competition and duplication of physical properties, with a resulting reduction in price of service. This is a theory much talked about and believed in by those unfamiliar with that basic natural law of competition in all things which is the order of the world. A transient success is sometimes attained by individuals or by states in the efforts to stifle competition, but the final result is usually a violent break up of the suppressed activities or the death of the thing suppressed. No society can long survive the lack of active competition in all its elements, and any government or division of government which attempts to eliminate the beneficial and life-giving effects of competition is but hastening the ultimate death of the society which it was formed to protect.

THE INSPIRATION OF COMPETITION

Competition in the physical world results in the adoption of new apparatus and the rejection of the old, a constant striving for betterment, the discovery of new principles of nature and the invention of new devices. The restriction of competition by governmental authority or otherwise carries with it a satisfaction with things as they are, the retention of old devices and outworn apparatus, a suppression of the new and generally a wasteful and expensive method of accomplishing a given result. In the intellectual world the one is the inspiration of never-ending youth, with an ever-widening horizon into the unknown domain of nature that leads on and on into the future; the other is that satisfaction with the accomplished fact, the setting of a limit to endeavor—an old age that presages extinction. It is of far more importance to preserve the spirit of youth and adventure in a nation than to set limits and bounds to the individuals in order that duplicate installations of certain physical plants be avoided and "society" be saved some money.

That any money is ever saved by the creation of monopolies by government is much to be doubted. By restriction of the rate of return to a definite sum based upon the value of the physical plant involved, commissions have taken from corporations all incentive to better their plants and eliminate waste. The writer once suggested to a corporation president the elimination of four separate small and wasteful plants and the substitution of one new plant to perform the same service. Immediately came the reply that from his standpoint nothing would be gained, as the commission in charge would merely make a corresponding reduction in his rate, leaving him with nothing but added financial responsibility for the cost of the new plant.

THE SPECIFIC CASE OF HYDROELECTRIC DEVELOPMENT

The generation of energy from falling water, its transmutation into electric energy and the transmission over long distances to the place of use originated in California and rapidly spread over this country and the world. The men who initiated and constructed the first experimental plants and by their vision, energy and daring demonstrated the feasibility of the idea contributed thereby to humanity such signal service that it can only be compared to that rendered by the inventors of the steam engine or the builders of the first railroads. It was one of the great mechanical achievements of all time. By the power developed in the distant mountains, cities are lighted, houses warmed, urban and interurban traffic is carried and flooded lands are drained or dry lands are irrigated. In short, the diversified life of a modern community exists with hydroelectric power as one of the vital elements. Nothing has been destroyed; the water still falls, and will fall when those who have strived to prevent this development will have passed away.

A MARK FOR ABUSE

Yet with all the benefits conferred and recognized, the corporations generating and distributing hydroelectric power became the mark for all phases of that unintelligent and unrestrained abuse so common to American life. No name was too harsh, no strictures were too severe for those who, under the existing laws, had appropriated and used the waters of mountain streams and made them serve mankind. According to some, the people of the country had been robbed of their birthright. The water powers of the country had been absorbed by the money trust. All the benefits arising from the use of water had accrued to the corporations and no benefit whatever rendered to the people.

Departments of the national government vied with each other in compiling statistics as to the extent and magnitude of the robbery, and legislation followed, with the states doing their share. The reader may recall how Mr. Roosevelt, early in his first term, vetoed a bill that permitted the building of a power plant on the James River, and thus saved the power for the people. One who takes second thought may be led to inquire as to the many thousands of tons of coal which have since been burned to furnish the equivalent of that energy, and which can never be regained. Possibly the plant was built in later years, but the example is typical. The point to be held clearly in mind is that unless one follows blindly the teachings of a state socialism, all of this outcry was a cry of wolf when there was no wolf, and the net result is disastrous.

CALIFORNIA'S REQUIREMENTS FOR WATER-POWER DEVELOPMENT

To appreciate the extent to which governmental control and restriction can go, one must pass in review the procedure necessary in order to establish a hydroelectric power company in California.

1. The issuance of securities, a vital concern with any project, is directed and controlled by the state commissioner of corporations under the "Blue Sky Law."

2. Most of the water powers of the state lie in mountains covered by the reserves of the national forests. The national government does not control the water, but it does own the land, and nothing but a permit can be obtained for rights-of-way. This permit compels the company to submit to restrictions as to rates charged and conduct of its affairs in parts of the state not subject to the jurisdiction of the United

States, and the permit for rights-of-way can be revoked at any time by the Secretary of Agriculture.

3. Outside of the national forests there is usually a fringe of United States lands in control of the Land Department. Rights-of-way can be obtained only by permit through a procedure similar to that of the Forest Service, and the permit can be revoked at will by the Secretary of the Interior. A permit given to the city of San Francisco by one secretary was revoked by another.

CONTROL OF WATER

4. The control of water rests with its owner, the state of California. A water commission has been formed having full control. Any company desiring to use water in the development of a hydroelectric power plant applies to the commission and receives, not a permit to use the water, but only one to build the plant. After having built the plant, the company again applies to the water commission for a license to use the water, which the commission may refuse or, if given, revoke at any time.

There is some doubt as to this latter point, as a member of the commission has expressed the opinion that the license must issue. That the reader may judge, the following extract is taken from the law creating the commission:

"Said license shall be in such form as may be prescribed by the state water commission under the provisions of this act. But if the said commission shall find, upon inspection and examination of the works constructed, that the construction and condition of said works are not in conformity with the law, the rules and regulations of the state water commission, the terms of the approved application and the terms of the permit, then and in that case the said commission may, after due notice in writing and in the manner provided in sections 1011, 1012 and 1013 of the Code of Civil Procedure to the applicant or the holder of the permit, and a public hearing thereon, refuse to issue said license."

In case of such refusal, an appeal can be had to the courts.

Be this as it may, it can readily be seen what uncertainty lies about the building of a power plant. Rarely does any project of moment involve an expenditure of less than $5,000,000, and no one can be found to advance money for such construction when the right to the use of the water can be obtained only after the plant is built, and possibly after a vexatious lawsuit. Other burdensome restrictions are incorporated in the law, such as that of sharing a constructed power station with a competitor if all the water in the stream is not used.

BROAD POWER OF STATE COMMISSION

5. Probably the chief deterrent to the building of new power plants in California is the State Railroad Commission, which has almost unlimited power over all public-service corporations. In the law forming the commission it is specifically exempted from the provisions of the state constitution, and as the law was approved by the people in referendum, it is supreme. Acting under the provisions of this law the commission has denied a certain power company the right to sell electric energy in one part of the state. The case was carried through the courts and determined in favor of the commission. It being possible for the commission to restrict the activities of any new company, and there being no restraint upon the caprice of a body the personnel of which changes from time to time, no one can venture to initiate any new enterprise.

DEVELOPMENT AT A STANDSTILL

This then represents in detail how governmental restraints have practically brought to a complete stop all new enterprises of the type in question and have thereby given the certificate of monopoly to those corporations which the accident of prior construction has placed in a controlling position. No one can be found who will venture the necessary funds for new plants when four separate governmental bodies, two national and two state, have the power to revoke permits, any one of which will compel a cessation of business. To those who think that state control will bring relief from national control the proceedings of California are offered as a subject for reflection.

It may be claimed that the existing companies can supply all necessary power for the future and that others are therefore unnecessary. To this the reply can be made that it is given to no one, least of all a government commission, to read the future and to determine in advance what the course of events will be.

An example will suffice. California is an agricultural state and even now needs artificial fertilizers, some of which can be produced by the electric process. Less than 10 per cent of the available water power is developed for use, and it is conceivable that, were the governmental restrictions removed, this much needed industry might be started. Under existing conditions, for any new company to start such an industry is practically impossible.

This is a criticism of measures and not of men. The men in charge of the various governmental bureaus are capable, honest and obliging, and their procedure is reasonably efficient. They, and all who favor them, are the victims of a false theory which has no basis in human experience. They have created a Frankenstein that apparently is now beyond the control of any one.

THE REMEDY

In order that these notes be other than expressions of discontent, it is necessary to set forth a different course to be pursued. Either the national forests should be removed from the control of the national government and given over to the states to which they belong, or the national government should submit to state laws in the same manner as any other owner of land. The former is preferable, as it would thereby reduce the powers of the national government in a domain where such reduction is vitally necessary. In any case, whether national or state, the permit system, with the right to cancel the permit resting in the hands of an official subject to no one, should be eliminated everywhere.

The lease of lands or water rights should be made the subject of a contract over a definite term and longer. This would remove the uncertainty which comes from the possibility of individual caprice. No land or water right should ever be granted in perpetuity to any one. The state should retain its eminent domain, but if it desires to grant the use of such properties it should do so in good faith and not, while seeming to grant rights of use, actually prohibit the use by the insertion of burdensome and unnecessary restrictions.

Finally, the power to stop any one from entering into any business should be taken from all commissions on the grounds that it is dangerous to American liberties to intrust such power to groups of public officials, however well intentioned. The commissions should use their powers and efforts to secure justice and fair treatment to all and not seek to establish and confirm monopolies by the suppression of competition.

GOVERNMENT AND THE MAN

Unfortunately the same tendency to resort to the government for a solution of all problems becomes more and more apparent in America. The flaccid tenets of socialism, by which men are taught to look to the government for all things, seem to be breaking down the self-reliance of the nation. The principle that no government can do as well for any man as that man can do for himself seems to have been lost sight of. All government is parasitic in its nature and those who labor for it produce nothing. As the powers of government are extended the privileges of the strong and powerful are confirmed as monopolies, the restraints and prohibitions upon the individual are multiplied and his struggle for expression and the right to live is everywhere opposed. From the restrictions of other individuals he may free himself, but from those of his government there is no appeal.

A final thought is that all this investigation, valuation and regulation produces little or nothing. Rarely are rates lowered, service bettered or financial dealings made more secure. Here and there some abuses are corrected and the tiresome procedure of law courts replaced by the more open forum of the commission hearing. The negative result is the diversion from real creative effort of the energies of the number of earnest men engaged in such profitless work, for it must always be borne in mind that except in such rare cases as the Panama Canal or the Reclamation Service no government ever created anything of value to humanity, being by its very nature restrictive and not creative.

Believing these things to be true, that present extension of governmental powers is inimical to all that represents progress in American life and that danger lies ahead on our present course, this article is written as a protest and a warning.

Experiment with Western Wood for Manufacture of Paper

A study of methods of barking, chipping, screening and baling chips was recently completed at the U. S. Forest Products Laboratory at Madison, Wis. Certain Western woods are said to be adapted for manufacture into pulp. It is estimated that some of these can be cut into chips which, when dried and baled, can be delivered to the mills in Wisconsin at a small advance over the cost of chips from local timbers. One of the serious problems connected with the drying of Western woods, particularly sugar pine, is a peculiar brown stain which develops during seasoning. In an effort to establish some method of kiln drying whereby this difficulty would be eliminated the laboratory secured a carload of sugar-pine logs and made test runs. The results indicate that a solution of the problem has been found.

Formulas for Width of Base of Gravity Retaining Walls

Neat Dimensions and Width of Footings Determined for Various Cases Based Upon Middle Third and Overturning Limits

By T. A. SMITH
Structural Engineer, Division of Valuation, Interstate Commerce Commission, Chicago

NO FORMULAS are in general use for determining the width of base for gravity retaining walls, some cut-and-try process usually being applied—a process which is slow and unsatisfactory unless the designer has had considerable experience in such work. The formulas presented herewith are practical expressions which can be applied to cases of walls on rock foundations or to footing courses on hard foundations in which the toe pressure is easily resisted by the foundation. These formulas can be applied directly and eliminate the use of approximate methods.

Safe design of an ordinary gravity retaining wall requires that the width of the base should be such that the following two conditions will be fulfilled: (1) The line of resultant pressure must fall a certain generally accepted safe distance back of the toe; (2) the unit bearing under the toe must not exceed the safe bearing resistance of the underlying material.

A wall may fulfill either one of the above conditions and yet fail if it does not fulfill the other. For example, a wall may rest on rock that has a high bearing resistance and yet fail on account of crushing of the toe if its base is not of such width that the resultant line of pressure falls some appreciable distance back of the toe. On the other hand, it is quite common to assume that a wall is safe if its resultant line of pressure falls within the middle third of the base. This, however, is not always the case, as the toe pressure under a wall with a comparatively soft foundation may be great enough to cause failure even though the resultant falls inside the middle third.

It can be seen offhand that a gravity wall on a rock foundation will fulfill the second condition if it fulfills the first, for, in any wall in which the resultant line of pressure falls an appreciable distance back of the toe, the toe pressure will be less than the bearing resistance of rock. The same is true for that portion of any wall above its footing course, because the footing course can be considered as a rock foundation for the portion of the wall above the footing. It follows, then, that in designing a wall on a rock foundation or the neatwork of any wall that has a concrete footing, it is necessary to fulfill only the first condition, and the second one will be satisfied automatically.

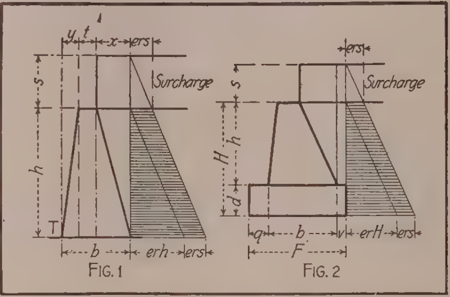


FIG. 1 FIG. 2

NOTATION FOR RETAINING-WALL FORMULAS

FORMULAS FOR TYPICAL GRAVITY WALLS

Fig. 1 shows a typical cross-section of the neatwork of a gravity retaining wall, the cross-hatched area back of the wall representing horizontal earth pressure The method of applying earth pressure is adopted from the recommended practice of the American Railway Engineering Association, Vol. 10, Part 2.

Using the notation indicated on the figure, and letting c be the weight of concrete per cubic foot, e the weight of earth per cubic foot, and r the ratio of horizontal earth pressure to vertical pressure, formulas have been derived and tabulated in Table 1 for the case where the resultant pressure falls at the limit of the middle third. In Table 2 are presented the formulas for the case where the righting moment is made equal to twice the overturning moment. In both tables the thickness of the wall at top t and the batter on one face is assumed and that for the other face computed, using constants which are evaluated for several of the most usual conditions, as indicated in the tables.

The condition that the resultant line of pressure must pass through the edge of the middle third requires a somewhat wider base than is usually provided for the neatwork of a gravity wall or for a wall on a rock foundation. The condition that the righting moment about the toe must be equal to twice the overturning moment gives results more consistent with common practice.

WIDTH OF FOOTINGS

The foregoing methods may also be applied, with certain modifications, to the determination of the width of footings. Fig. 2 shows a typical cross-section of a gravity

Case	Numerical Values Used	Amount of Batter y on Face of Wall given. $x=\frac{1}{2}(\sqrt{A^2+4B}-A)$ Width of Base $b=y+t+x$	Amount of Batter x on Back of Wall given. $y=\frac{1}{2}(\sqrt{C^2+4D}-C)$ Width of Base $b=y+t+x$	Amount of Batter y on Face of Wall given. $x=\frac{1}{2}(\sqrt{A^2+4B}-A)$ Width of Base $b=y+t+x$	Amount of Batter x on Back of Wall given. $y=\frac{1}{2}(\sqrt{C^2+4D}-C)$ Width of Base $b=y+t+x$
1	General	$A=\frac{chy+2e(h+2s)(y+t)}{e(h+s)}$ $B=\frac{h[erh(h+3s)-c(y^2+3ty+t^2)]}{e(h+s)}$	$C=3t+x+\frac{2ex}{c}+\frac{4esx}{ch}$ $D=\frac{e}{c}[rh(h+3s)-x(x+2t)-\frac{sx}{h}(x+4t)]-t^2$	$A=\frac{3(y+t)[h(c+e)+2es]}{h(c+2e)+3es}$ $B=\frac{h[2erh(h+3s)-c(2y^2+6ty+3t^2)]}{h(c+2e)+3es}$	$C=3(t+\frac{x}{2}+\frac{ex}{2c}+\frac{esx}{ch})$ $D=\frac{e}{c}rh(h+3s)-\frac{1}{2}(3t^2+3tx+x^2)-\frac{ex}{2c}(3t+2x)-\frac{3esx}{2ch}(2t+x)$
2	c=150 e=100	$A=\frac{3hy+4(h+2s)(y+t)}{2(h+s)}$ $B=\frac{h[2rh(h+3s)-3(y^2+3yt+t^2)]}{2(h+s)}$	$C=3t+\frac{7x}{3}+\frac{8sx}{3h}$ $D=\frac{2}{3}[rh(h+3s)-x(x+2t)-\frac{sx}{h}(x+4t)]-t^2$	$A=\frac{3(y+t)(5h+4s)}{7h+6s}$ $B=\frac{h[4rh(h+3s)-3(2y^2+6ty+3t^2)]}{7h+6s}$	$C=3t+\frac{5x}{2}+\frac{2sx}{h}$ $D=\frac{2}{3}rh(h+3s)-\frac{1}{6}(9t^2+15tx+7x^2)-\frac{sx}{h}(2t+x)$
3	c=150 e=100 s=0	$A=\frac{y}{2}+2t$ $B=rh^2-\frac{3}{2}(y^2+3ty+t^2)$	$C=3t+\frac{7x}{3}$ $D=\frac{2}{3}[rh^2-x(x+2t)]-t^2$	$A=\frac{15}{7}(y+t)$ $B=\frac{1}{7}[4rh^2-3(2y^2+6ty+3t^2)]$	$C=3t+\frac{5x}{2}$ $D=\frac{2}{3}rh^2-\frac{1}{6}(9t^2+15tx+7x^2)$
4	c=150 e=100 y=0	$A=\frac{2t(h+2s)}{h+s}$ $B=\frac{h[2rh(h+3s)-3t^2]}{2(h+s)}$		$A=\frac{3t(5h+4s)}{7h+6s}$ $B=\frac{h[4rh(h+3s)-9t^2]}{7h+6s}$	
5	c=150 e=100 y=0 s=0	$A=2t$ $B=rh^2-\frac{3}{2}t^2$		$A=\frac{15}{7}t$ $B=\frac{1}{7}(4rh^2-9t^2)$	
6	c=150 e=100 x=0		$C=3t$ $D=\frac{2}{3}rh(h+3s)-t^2$		$C=3t$ $D=\frac{2}{3}rh(h+3s)-\frac{3}{2}t^2$
7	c=150 e=100 x=0 s=0		$C=3t$ $D=\frac{2}{3}rh^2-t^2$		$C=3t$ $D=\frac{2}{3}rh^2-\frac{3}{2}t^2$

TABLE 1—RESULTANT LINE OF PRESSURE AT EDGE OF MIDDLE THIRD

TABLE 2—RIGHTING MOMENT IS TWICE OVERTURNING MOMENT

<table>
<tr><td colspan="3">Assume or Determine Numerical Values for the Following:
c e r h s d H L g b P</td></tr>
<tr><td>Case</td><td>In addition to the above, assume value for v.</td><td>In addition to the above, assume value for q.</td></tr>
<tr><td rowspan="4">1-Resultant Falls at Edge of Middle Third.</td><td>$A=\frac{4[L+ev(h+s)]}{cd}+2(b+v)$
$B=\frac{2L(b+v-3g)-ev(h+s)(4b+v)+erH^2(H+3s)}{cd}-(b+v)^2$
$q=\frac{1}{2}(\sqrt{A^2+4B}-A)$</td><td>$C=2\frac{[cd+2e(h+s)](g+b)-L}{cd+e(h+s)}$
$D=\frac{2L(b-3g-2q)-cd(q+b)^2+erH^2(H+3s)}{cd+e(h+s)}$
$v=\frac{1}{2}(\sqrt{C^2+4D}-C)$</td></tr>
<tr><td colspan="2">$F=q+b+v$</td></tr>
<tr><td colspan="2">$P_t=2\left[\frac{L+ev(h+s)}{F}+cd\right]$</td></tr>
<tr><td colspan="2">If P is less than P_t Apply Case 2. If P is between P_t and $1\frac{1}{2}P_t$ Make no Change. If P is greater than $1\frac{1}{2}P_t$ Apply Case 3</td></tr>
<tr><td rowspan="2">2-Toe Pressure Limited to P lb. per sq. ft</td><td>$A=2\left[\frac{L+ev(h+s)}{P-cd}+b+v\right]$
$B=\frac{2L(2b+2v-3g)-ev(2b-v)(h+s)+erH^2(H+3s)}{P-cd}-(b+v)^2$
$q=\frac{1}{2}(\sqrt{A^2+4B}-A)$</td><td>$C=2\frac{[P-cd+e(h+s)](g+b)-2L}{P-cd-e(h+s)}$
$D=\frac{2L(2b-q-3g)-(P-cd)(q+b)^2-erH^2(H+3s)}{P-cd-e(h+s)}$
$v=\frac{1}{2}(\sqrt{C^2+4D}-C)$</td></tr>
<tr><td colspan="2">$F=q+b+v$</td></tr>
<tr><td rowspan="2">3-Righting Moment about Toe Equals Twice the Overturning Moment.</td><td>$A=2\left[\frac{L+ev(h+s)}{cd}+b+v\right]$
$B=\frac{2erH^2(H+3s)-6Lg-3ev(h+s)(2b+v)}{3cd}-(b+v)^2$
$q=\frac{1}{2}(\sqrt{A^2+4B}-A)$</td><td>$C=2(q+b)$
$D=\frac{2erH^2(H+3s)-6L(g+q)-3cd(q+b)^2}{3[cd+e(h+s)]}$
$v=(\sqrt{C^2+4D}-C)$</td></tr>
<tr><td colspan="2">$F=q+b+v$</td></tr>
</table>

TABLE 3—FORMULAS FOR WIDTH OF RETAINING-WALL FOOTINGS

wall with a footing course. The following notation, in addition to what has already been given and shown on the figures, is used: *L* is the weight falling within the base of the neatwork; *g*, the distance from the toe of the neatwork to the center of gravity of vertical loads on base of neatwork; *P*, the allowable unit bearing under the toe of the footing; P_t, the actual unit toe pressure obtained by formula; *W*, the total bearing on base of footing; and *Q*, the distance from the toe of footing to the resultant line of pressure.

The formulas in Table 3 have been derived for three cases, as there noted. It must be remembered that *v* and *q* are dependent upon each other. In solving for the footing offset at the toe, a numerical value must be assumed for the offset at the heel, or, if the offset at the toe is fixed, say by a property line or street line, the numerical value of *q* is assumed and the value of *v* found, after which the total width of footing is obtained.

If P_t is found to be greater than the allowable soil bearing, the footing must be made wider. On the other hand, if P_t is found to be less than the allowable bearing, the footing can be made narrower; but this is not to be recommended unless the foundation is rock or a soil that has a safe bearing resistance at least 50 per cent greater than P_t. In this case the same rule can be applied to the wall that has been applied to the neatwork—that is, the footing should be made wide enough so that the sum of the righting moments about the toe is equal to twice the sum of the overturning moments.

After having determined the dimensions of the neatwork by the use of Table 1 or Table 2, a trial width of footing and the corresponding toe pressure may be found by the use of the formulas under Case 1, Table 3. If the toe pressure varies much from the allowable safe toe pressure *P*, recalculate the width of footing, using the formulas in Case 2 or 3, according to the directions under Case 1. The footing must then be investigated for strength against bending under the edge of the neatwork. Steel reinforcing may be required or it may be necessary to make the footing thicker. If it is made thicker, the width will probably have to be recalculated.

The formulas in Table 3 can also be applied to abutments and to reinforced-concrete retaining walls. Any irregularity in size or shape of neatwork is taken care of automatically in calculating the values of *L* and *g*.

Government Survey to Be Made on Pacific Coast

The government will begin next year a resurvey of the Pacific Coast from Mexico to Alaska, extending at some points 10 miles from shore, according to recent announcements made in San Francisco through the coast pilot section of the Coast and Geodetic Survey service. The survey will probably include wire-drag work in the smaller harbors of the coast for uncharted rocks. It is primarily a hunt for submerged valleys and pinnacle rocks, it is stated. Particular attention will be paid to waters along the Mendocino coast in northern California, where there have been found many abrupt holes 300 fathoms or more in depth on a bottom otherwise 40 to 60 fathoms below the surface. The work will be directed chiefly from the Coast and Geodetic Survey steamer "Surveyor," which is to be sent around from the Atlantic Coast early next year.

Reports on Year's Operation of Fitchburg Sewage Works

F. W. Jones, Chemist, Gives Experiences in the Maintenance of Imhoff Tanks and Sprinkling Filter

THAT the sewage-treatment plant at Fitchburg, Mass., consisting of Imhoff tanks and sprinkling filter, is turning out a good effluent and is fulfilling the purpose for which it was designed is the conclusion reached by Frank Woodbury Jones, supervising chemist, in his latest annual report to David A. Hartwell, chief engineer of the Sewage Disposal Commission. The report covers operation for the fifty-two weeks beginning Dec. 4, 1914, and ending Dec. 2, 1915. The Fitchburg plant was described in the Engineering Record of June 7, 1913, page 633. Extracts from Mr. Jones' report on operation follow:

SCREENINGS

The bar screen at the siphon chamber with a clear space of 1⅝ in. has been in use during the entire year. It is raked twice daily, and once each week the accumulated material, consisting largely of paper, rags, fruit skins, offal, etc., is measured, taken from the chamber and buried near-by. A total of 510 cu. ft. was collected and removed. Calculations during dry-weather-flow periods show that the screenings amount to 0.5 to 0.6 cu. ft. per 1,000,000 gal. of sewage screened.

The disposal works proper have been in operation a total of 321 days, leaving 43 days when the whole plant was shut down, the reasons for this being: (1) Repairs to the blow-off valve, which required a wait of 10 days; (2) connection for the Bemis Road siphon and alterations to the dosing tanks taking 29 consecutive days; and (3) high storm flows at various times aggregating 4 days.

IMHOFF TANKS

All the Imhoff tanks were in use until May 14, when with the coming of warm weather it seemed advisable to operate but two tanks at one time, since the flow of sewage was not large enough to insure a nonseptic effluent. This policy was continued throughout the rest of the year. The period of detention has varied therefore from 10 hours or more to about 3 or 4 hours.

To insure the intended working of the tanks it is found necessary to poke the slots for a short time daily to provide free travel for the sludge to the digestion compartment. If this is done regularly there is no trouble, but if neglected the tanks become unsightly with patches of floating sludge.

The scum in the side walls varied in depth from nothing to 6 ft. When noted in any large amount it was agitated with a stream of water or plunger and thus kept from becoming hard and impervious. Gas rises constantly, but not vigorously, and as yet there has been but little foaming, and then only in one tank.

The surface of the sedimentation chamber is kept as free as possible from floating grease balls, etc., by frequent skimming, and to prevent clogging of the nozzles by material which escapes by the scum boards, screens made of cellar window wire, ¼-in. mesh, were placed at the outlet ends of the tanks on March 9. While not eliminating nozzle clogging, these screens have proved of sufficient value to warrant continued use.

The direction of the flow was reversed six times, and the sludge, from measurements taken by means of a small pitcher pump coupled to a 1-in. hose calibrated in 1-ft. lengths, has been found to assume a fairly uniform depth in the digestion compartment.

A total of 725,355,000 gal., a daily average of 2,261,800 gal., has been treated in the Imhoff tanks giving an average removal of 70.2 per cent of the total suspended matter, or 97.6 per cent of the settleable solids. This amounts to a total of 459.4 tons of dry solids deposited in the tanks. The sewage is largely domestic, the principal trade waste being a small quantity of settled wool scouring liquor. The total fat in one week's composite was 59.8 parts per million in the crude sewage and 38 parts in the Imhoff tank effluent.

SPRINKLING FILTER

During the 316 days the sprinkling filter has been in operation 671,889,000 gal., a daily average of 2,123,500 gal., of settled sewage has been filtered. This is practically 1,000,000 gal. per acre per day, or 62.4 gal. per cubic yard of stone per day. The difference between the amount treated on the filter and in the Imhoff tanks is due almost entirely to storm conditions when the settled sewage was bypassed wholly or in part.

The dosing cycle, with a rate of 3,500,000 gal. per day, is about 36 minutes. This gives two doses of 5½ minutes each and two rest periods averaging 12½ minutes each.

The distribution has always been good, but was decidedly improved by the alterations to the dosing tanks. Besides the increased efficiency of distribution, as a result of the added head a quantity of sewage sufficient to prevent ice formation now reaches the points farthest from the nozzles. Last winter the filter had only an open ring in extreme weather; but this winter the bed is almost free from ice except for a crater around each nozzle.

There has been comparatively little trouble with clogged nozzles, as the obstructing material is removed as soon as noted. In all 5969 nozzles, a daily average of 19, were reported cleaned, the material removed consisting mostly of small grease balls, matches, leaves, grass and growths. Many other substances are taken out at times, however, varying from rats and toads to feathers and buttons. The number of nozzles cleaned varies with the seasons and weather conditions. In times of storm, matches and grease balls predominate; in the fall dead leaves and bunch grass blow into the channels and dosing tanks in spite of the covering; and in the early and late winter considerable quantities of growth become detached from the distribution pipes and fill the orifices. Last winter only twelve nozzles were frozen.

The surface of the bed has shown very little tendency to pool; in the early spring some growth appeared and small ponds began to form, but by picking the stones at these places no permanent pooling resulted. This care takes very little time, adds to the appearance of the filter, and is necessary for only a short part of the year. During the summer the top stones were covered with green growth, but at all times 4 in. or less beneath the surface the stones were clean and healthy and coated with a gelatinous film swarming with small white worms.

On, Feb. 25 the first white flies were noticed, and from then until the latter part of May they were much in evidence, creating a considerable nuisance even in the laboratory. About June 1 they disappeared and a small black fly came instead. These flies remained on the bed until the plant shut down in September, and were not troublesome.

The distribution pipes have been drained three times onto the sand filter south of the stone filter. This cleans the pipes of all stagnant sewage and whatever sludge has accumulated in the invert. The underdrains have been flushed but once, and then to dislodge the dust that was washed from the stones.

The filter stored up solids until about the middle of April, when the unloading began. This continued up to the last of September, the greatest amount of suspended matter appearing in the effluent during May, June and July. Only 11.5 per cent of the suspended matter applied to the filter has been permanently disposed of in the filter.

SECONDARY TANKS

The secondary or post-filter tanks have been in operation in conjunction with the sprinkling filter except for short periods of cleaning, when one or more tanks were shut off. At Christmas time in 1914 the surface of the tanks froze over, but the operation was not interrupted. The tanks were first cleaned in June and again in July and September. The sludge, which flowed readily, had an odor characteristic of humus sludge and a consistency similar to that of soft whipped cream. The specific gravity of the liquid sludge averaged 1.034, and the average per cent of total solids at each pumping was found to be 10.56, 10.22 and 7.74 respectively. Each tank was completely emptied and thoroughly washed before operation was resumed. Owing to difficulties with the pump caused by boys throwing stones and wire into the tanks, it was impossible to pump all the sludge into the Imhoff tanks. Since the novelty of the plant has worn off this trouble has lessened. The effluent from the secondary tanks contains but little suspended matter, has a sparkle and after splashing down the steps reaches the river as a clear stream.

SLUDGE DISPOSAL

The first sludge was drawn from the Imhoff tanks on June 14, and the eleven beds have been filled three times and cleaned twice. July and August were such wet months that sludge drying was practically impossible. A total of 274,838 gal. was pumped from the Imhoff tanks, representing a total of 157.9 tons of dry solid matter. The total solids in the sludge as pumped were as follows: Tank 1, 9.48 per cent; tank 2, 11.86 per cent; tank 3, 14.11 per cent; tank 4, 13.89 per cent; tank 5, 16.79 per cent; average, 13.23 per cent. The volatile or organic matter in the dry solids averaged 44.61 per cent of the total in the sludge removed from tanks 1, 2, and 4.

The sludge as pumped onto the beds varied in depth on different beds and on the same bed, as for the most part it was thick and did not flow freely. The average depth, however, may be taken as 6 to 8 in. On first appearance the sludge had a distinct tarry odor, but close inspection showed that digestion had not been complete. No objectionable odor was noticed except from the sludge of one tank, which created a nuisance for about a week. This tank had not received any humus sludge and the lack of digestion was very apparent. Another tank, which also had received no secondary tank sludge, pumped later in the season, showed progress in the digestion of the sludge which gave rise to no objectionable odors. It might be noted at this point that for a sewage-disposal works there has been little nuisance caused by bad odors. During the hot weather some odor developed, but, except for the case mentioned, there has been no more than could reasonably be expected at a place where human waste from the whole city is concentrated.

The sludge as it reaches the bed contains air and gas in considerable amount and readily rises in a graduate cylinder, leaving clear water at the bottom. On the bed the sludge rises, then falls, leaving a spongy mass, which cracks and dries into a porous cake.

The shortest period between pumping and removal from the bed was 27 days. The sludge was then a dry odorless cake, easily forked into the sludge cars, and contained an average of 62.73 per cent solids, or 37.27 per cent moisture.

TYPICAL RESULTS OF SLUDGE DISPOSAL

The following data show typical results of sludge disposal: On July 13, 16 and 17, 33,164 gal. of sludge, specific gravity 1.034, having an average content of 11.86 per cent total solids, containing 44.29 per cent volatile or organic matter, was pumped from Imhoff tank 2 onto five beds. The average depth on the beds as pumped was 6 to 8 in. On Aug. 26 this same sludge, reduced to an average depth on the beds of 1¾ in., was removed, requiring 59 1-yd. car loads with an average weight of 1260 lb. per yard and a moisture content of 45.09 per cent. Some of the sludge taken from the beds was used for filling a washout in the bank near the car dump and the rest was spread on the slopes and around the shrubs. The cost of removal from bed to sludge dump in cars averaged 14 cents per yard load, and that of hauling from the dump to points of disposal about the works 40 cents per yard load.

The compressed-air lift operates satisfactorily and under normal conditions uses about 8 kw. per hour in delivering about 8000 gal. of sludge.

How University-Extension Service Does Engineering-Promotion Work

For the last three years the Wisconsin University extension service has maintained a municipal and sanitary division. The growth of the work is indicated in a recent report by George R. Bascom, engineer in charge. The number of communities served for three consecutive years was 11, 27 and 36; subjects treated, 13, 42 and 53, and trips made, 4, 13 and 11 respectively.

The problem of popularizing the engineering features of a public improvement and stimulating the public to action is a matter of promotion and publicity rather than of engineering. The end of a preliminary survey marks the line between promotion services and engineering services. The selection of an engineer is handled by the service furnishing a list of all similar utilities in the state, with the advice to write to any or all of the places for detailed information regarding the engineers who had charge of the work, what the results were and for any other data leading to the selection of a competent engineer.

THREE INTERCONNECTED CONCRETE PLANTS BUILD ELEVATOR UNIT OF 104 CELLS

Run of 1200 Yards in Twenty Hours Made with Conveyor System for Concrete Aggregates

Gravel and Sand Came in Bottom-Dump Cars—Cement Handled Directly from Cars to Three Mixer Units Building Large Grain Elevator

A RECORD of 1200 cu. yd. of concrete deposited in twenty consecutive hours was made Aug. 23 on the new 6,000,000-bu. grain elevator which the Chicago & North Western Railway Company is building for the Armour Grain Company at 124th Street and the Calumet River, Chicago. There are in the storage portion being built at present 104 circular bins, 105 ft. high and 22½ ft. in diameter. They are being constructed by the continuous rising-form method. The entire bank of 104 tanks, aggregating 168 yd. per vertical foot, was under construction when the record was made. Sand and gravel were supplied to the mixers by mechanical equipment that eliminated all hand work, and to this fact the contractor attributes the success of the concrete plant. Belt conveyors carry the aggregate from the bins into which bottom-dump cars discharge to the charging bins over the mixer, but there is an intervening "storage reservoir" of 2800 yd. capacity between the cars and the mixer, so that any temporary irregularity in the supply of material is equalized.

CONCRETE-SUPPLY PLANTS

There are three complete concrete plants erected in a line at the south end of the bank of tanks. Parallel with this line and 150 ft. farther to the south is the "reservoir," a 200-ft. length of material bins supplied at the west end by a track running north and south. A cross belt conveyor connects the storage bins with a conveyor running over the top of each individual mixer storage bin. A track with a continuous platform along the line of the mixers enables the supply of cement to be maintained with little use for the small 600-bbl. sheds placed for emergency near each plant.

HANDLE BOTTOM-DUMP CARS QUICKLY

Beginning at the aggregate end bottom-dump cars, three at a time, are hauled up a slight incline by a one-drum 22 hp. electric hoist over four hoppers. From one of them the material drops directly on to a 315-ft. 24-in. conveyor delivering to the storage bin. This runs at 300 ft. per minute up an incline on a 20-deg. slope and has a capacity of 200 yd. per hour. The three other hoppers under the cars feed a belt running parallel with the track and discharging on the main supply conveyor. Two cars may be dumped at one time, and as many as five cars have been unloaded per hour. The heat was so intense this summer that a shed had to be built over the unloading outfit.

The belt over the storage bin is 36 ft. above ground level and a traveling tripper works back and forth distributing the sand and gravel evenly over the length of the respective bins. The gravel bin holds 1800 yd. and the sand bin 1000 yd. A second belt, 4 ft. above ground, draws from the storage bins, which were built entirely above ground on account of the boggy nature of the site, and discharges on the cross-conveyor. The latter elevates the material about 40 ft. and discharges it either directly into the central-plant hopper or onto belts running to the plants at each end of the line.

Each concrete unit consists of a 140-ft., two compartment tower, a 1-yd. Marsh-Capron mixer, and a system of chutes with a swivel leg and balanced cantilever discharge spout reaching a maximum of 100 ft. from the tower. Aggregate bins of 40 and 80-yd. capacity for sand and gravel respectively deliver into the mixer through measuring chutes, and in less than a minute a bucket of concrete is mixed and shot up the tower at the rate of 300 ft. per minute by a 90-hp. special Thomas elevator hoist.

Water for the mixers was supplied from the river by means of a 4-in. triplex pump driven electrically by a starterless Wagner motor controlled by an Anderson automatic cutoff switch. The service was such as to start the pump operating every few minutes to keep up the required 80-lb. pressure.

DISTRIBUTION OF LABOR

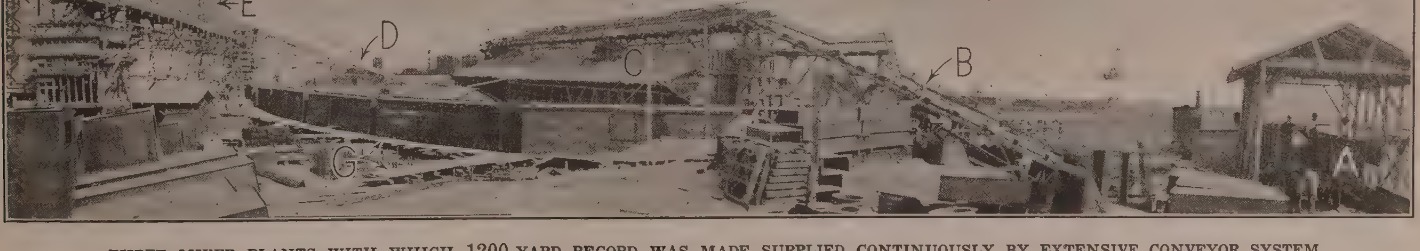
The distribution of men engaged in the concreting process is as follows: Eight men unloading cars, three men attending to the conveyor belts, six men handling cement; and for each plant in use two men manipulating levers for aggregate and water; one man on the hoist; and one man at the top of the tower. The number of men handling chutes, spreading concrete and manning the jacks to raise the forms varied too much to give accurately.

It is to be noted that the 1200-yd. record was made with only one mixer outfit, which operated continuously two 10-hour shifts, or a total of 20 hours.

During the extreme dry and hot weather the 315-ft. main supply cotton belt stretched to an extent which could not be compensated for by the take-up and which proved a source of annoyance. To obviate this difficulty wetting of the under side of the belt with a hose was resorted to. This proved efficacious, and thereafter the belt was thoroughly wetted every three days for a period of two hours. The conveyor system was furnished by the Stephens-Adamson Manufacturing Company.

The whole job is operated by electricity, a temporary transformer station to bring the 12,000-volt current of the Commonwealth Edison Company down to 220 volts being erected just outside of the limits of the work. A switchboard backed by asbestos, controlling all circuits, is located in the same shed with the central concrete elevator hoist. The entire installation was designed by the contractors' organization and installed by the Thomas Elevator Company, which furnished the hoists for the concrete towers and the car puller.

The Witherspoon-Englar Company and Grant Smith & Company are the general contractors for the elevator.



THREE MIXER PLANTS WITH WHICH 1200-YARD RECORD WAS MADE SUPPLIED CONTINUOUSLY BY EXTENSIVE CONVEYOR SYSTEM

Railway cars at right unloaded into hoppers feeding belt under track. This belt discharges on inclined conveyor *B*, which loads large storage bins *C*. A belt under these bins feeds the inclined cross-conveyor *D*, which delivers material at the center concrete plant *E*, for use there or to be conveyed to the west plant *F*, or the east plant, out of sight behind the right corner of the tanks. Cement is handled on the runways *G*.

Literature

For the Civil Engineer and Contractor

New Publications

Building Zone Maps of New York City. Three bound volumes; 35 sections each; 19½ x 28½ in. New York, Joseph Haig, secretary, Board of Estimate and Apportionment, Municipal Building. $1 each, $3 per set; 5 cents per section.

Each volume is confined to one set of restrictions, one showing the use districts, one the height districts and one the area districts. Each sheet, to the scale of 1000 ft. to the inch, covers about 9000 acres.

Handbook of Rock Excavation Methods and Cost. By Halbert Powers Gillette, managing editor of *Engineering and Contracting*. Flexible leather, 5 x 7½ in.; 825 pages; illustrated. New York, Clark Book Company, Inc. $5 net.

Vocational Psychology. By H. L. Hollingworth, associate professor of psychology, Columbia University. Cloth, 5 x 8 in.; 308 pages. Issued as one of the "Conduct of Mind Series," edited by Joseph Jastrow. New York, D. Appleton & Company. $2 net.

U. S. Geological Survey Bulletins. Paper, 6 x 9 in.; illustrated. Washington, Government Printing Office.

The Chisana-White River District, Alaska. by Stephen R. Copps. No. 630, 130 pages.

Antimony Deposits of Alaska. By Alfred H. Brooks. No. 649, 67 pages.

Bibliography for North American Geology for 1915. By John M. Nickles. No. 645, 144 pages.

Spirit Leveling in Georgia, 1896 to 1914 inclusive. No. 635, 60 pages.

Spirit Leveling in Arkansas, 1896 to 1915 inclusive. No. 636, 56 pages.

Spirit Leveling in New Mexico, 1902 to 1915 inclusive. No. 638, 112 pages.

New Chart of Passaic and Hackensack Rivers, New Jersey. No. 287, U. S. Department of Commerce. Scale 1:20,000 (3.2 in. to the mile). 28½ x 40¾ in. Washington, Government Printing Office. 50 cents.

This new chart, on a large scale, includes both rivers from their junction at the head of Newark Bay up as far as the cities of Passaic and Hackensack.

Water Supply Papers, U. S. Geological Survey. Paper, 6 x 9 in.; illustrated. Washington, Government Printing Office.

Surface Water Supply of the United States, 1914. Part 4, St. Lawrence River Basin; No. 384, 128 pages: Part 7, Lower Mississippi River Basin; No. 387, 60 pages.

Colorado River and Its Utilization. By E. C. La Rue. No. 395, 230 pages.

Books Reviewed

Stresses in Structures

Author, A. H. Heller, C.E., late professor of structural engineering, Ohio State University. Third edition. Revised by Clyde T. Morris, professor of structural engineering, Ohio State University. Cloth, 6 x 9 in.; 374 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $2.75 net.

Those who are familiar with the previous editions of Heller's textbook on "Stresses in Structures" will recognize that several improvements and additions have been made by Professor Morris and the publishers in this (the third) edition. While little change will be found in the first four chapters, in many places the concise explanations in the original edition were found by experience in the classroom to be difficult for students to understand, therefore Professor Morris has expanded these explanations and added numerical examples to illustrate the methods.

An explanation of the Bow notation for graphical diagrams has been included, and a new article giving the analytic solution for stresses in a derrick introduced. In the chapter treating stresses caused by uniform loading solutions have been added for deck Pratt, subdivided Warren, Whipple and Pettit trusses, and for skew bridges. In Chapter 13 a complete solution for stresses in a Pratt truss railroad bridge for Cooper's E-40 loading has been given, and a moment table for this loading added. In Chapter 14 a more complete explanation is presented of the solution for stresses in bridges with curved track. Many of the illustrations have been redrawn and a large number of new diagrams included.

A special feature of this book, which teachers who may not be familiar with it will find helpful and suggestive, is the great number of questions and problems listed at the end of each chapter to cover the subject treated. The typographical work is fully up to standard, and difficult mathematical solutions of the problems effectively reproduced.

Centrifugal Pumps and Suction Dredgers

Author, E. W. Sargeant. Cloth, 6½ x 9 in.; 188 pages; 160 illustrations; 14 folding plates. Philadelphia, J. B. Lippincott Company; London, Charles Griffin & Company, Ltd. $3.25 net.

Reviewed by A. G. Hillberg

Hydraulic Engineer, New York City

The author of this book has based his work upon an experience of more than thirty years in the field of the design and construction of all classes of centrifugal pumping machinery. Realizing that most books on the subject deal with the theoretical side, and that there was a distinct need of a treatise dealing with the practical details of the design, the author has written a book that will be of service to designers, draftsmen and operating engineers.

After dealing briefly with the evolution of the centrifugal pump, the author explains in an elementary way the fundamental principles underlying and governing the action of such pumps. Three chapters entitled "Principles of Design" show how the necessary computations are made. Chapter 6 treats the forms of pump casings, and completes the theoretical part of the book.

The more practical subjects presented in the following chapters are: Pattern making; molding and machinery used in manufacture; various types of pump casings; operation of pumps, and the relative merits of pumps in series and in parallel. Chapter 12 explains the use of high-capacity pumps on low heads, such as are encountered in irrigation and drainage work. The next two chapters are devoted to priming, or charging, as the author calls it, which deals with automatic priming.

Testing of centrifugal pumps is discussed in the next chapter, four different methods for measuring the discharge being explained. One method, however, is not mentioned—the chemical method, in which a small quantity of concentrated salt solution is injected into the suction pipe and the degree of dilution determined at the delivery end. Chapter 16 explains piping arrangements and valves, with a design for the friction loss in feet head for each 100 ft. of pipe. The use of centrifugal pumps and installations for drainage, irrigation, sewage and for salvage of wrecks and fire pumps are discussed in several chapters.

An important chapter entitled "Centrifugal Pumps Driven by Steam Turbines" is followed by one on rating air pumps and their applications to condensers. One of the fields in which the centrifugal pump has proved very successful is the dredging of sand, mud, silt, light clay, gravel and stones from the bottom of rivers, docks and harbors. Several forms of such pumps are described, with details, and several forms of suction dredges shown. The following chapter is a continuation of the same subject, but confined to the details of cutter gears.

The last two chapters deal with dredgers of simple design—that is, the arrangement of small plants satisfactory to meet simpler demands and which can be mounted on ordinary barges; and transporter dredgers—dredgers designed to discharge hopper barges. An appendix contains useful tables, such as dimensions, horsepowers, discharges, costs, etc.

The author has succeeded in writing a very interesting volume that should appeal strongly to engineers engaged in manufacturing, installing and operating centrifugal pumping machinery. The illustrations have been selected carefully and add materially to the value of the book. The volume should also appeal to students, as it is clearly written and easily understood.

Transportation Rates and Their Regulation

Author, Harry Gunnison Brown, assistant professor of economics, University of Missouri. Cloth, 5½ x 8 in.; 347 pages; illustrated. New York, Macmillan Company. $1.50 net.

Reviewed by W. J. Cunningham

Professor of Transportation, Harvard University, Cambridge, Mass.

Professor Brown in this book deals with the subject from the point of view of national wealth, and by applying the test of general economic welfare. The question is not whether certain rate-making principles or practices are good for the railroads or whether they are good for the shippers, but rather whether they are good for the nation. The author aims to make clear the inner philosophy of rate-making and rate regulation and to show why certain practices are economically justified and others should be disapproved. He aims also to point out "the reasons of public policy which sometimes do, and which always should, lie back of and condition our legislation."

The first chapter deals with the cost of transportation and its relation to rates. His classification embraces four groups of expenses or costs: (1) Train expenses—those pertaining most particularly to the moving of goods. These tend to vary, but not directly so, with distance. (2) Terminal expenses, which vary with the volume of traffic, but bear no direct relation to the distance goods are carried. (3) General expenses, or preparatory or complementary expenses, which bear only a remote relation either to the volume of traffic or to the distance the traffic is transported. (4) Fixed charges, consisting of interest charges, rentals and the like. In including the fourth class under "expenses," Professor Brown departs from the commission's accounting principles, which differentiate between operating expenses and charges (deductions from income). But as the author uses the words "expenses" and "costs" interchangeably it is evident that he means "costs" in both cases. He is not so much at home in discussing the details of expenses as he is in dealing with rate theories and economic principles, but the chapter on costs is illuminating and is a fitting prelude to the better chapters which follow.

These deal with (Chapter 2) competition of transportation companies, (3) transportation monopoly, (4) economically undesirable rate discrimination among places, (5) economically defensible discrimination among places, (6) relative rates on different goods, (7) discrimination among shippers, (8) steps in the development of rate regulation in the United States, (9, 10 and 11) rulings of the Interstate Commerce Commission on: (a) Reasonable rates, (b) discrimination among places, and (c) discrimination among different goods and among different shippers; and, finally, (Chapter 12) uneconomical government interference with, and encouragement of, transportation.

Professor Brown defines four classes of competition: (1) Of different companies, (2) of routes, (3) of directions and (4) of locations. Each class is clearly described, and his treatment of the economic justification of permitting uniformity in rates on both the long and the short route, of preferential rates for import and export traffic and of variation in rates between two opposite directions is particularly good. He defends, within certain limits, formal rate agreements and pooling between competing companies. He suggests that it would be advisable for the Interstate Commerce Commission to legalize rate agreements and pooling, when consented to and supervised by the commission. He criticises the "basing-point system" as a comparatively artificial selection, and a building up of wholesale or jobbing centers, as contrasted with a possible selection and development less artificial and more desirable which would not concentrate business at a favored point.

The chapter outlining the steps in the development of rate regulation in the United States covers the whole field in admirably condensed, yet well-balanced form. The same may be said of the three chapters which deal with the rulings of the Interstate Commerce Commission.

While the book is of prime value to students in economics, it is worthy of careful reading by railroad executives and traffic officials. To those railroad men who are not well grounded in economics the author's clear analysis of the underlying principles in rate making and rate regulation cannot fail to be helpful and broadening.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Manufacturers Should Tell What Parts Wear Out First

SIR: The writer has been interested in two letters which have appeared in your columns urging manufacturers to tell what parts wear out first, the first by Major Amos A. Fries, on Sept. 30, page 419, the second by J. P. Stone, Oct. 14, page 479. I wish to present the manufacturer's opinion of this question to a limited extent.

It is quite a customary practice among manufacturers of air-compressing and rock-excavating equipment to supply contractors and other users with stocks of repair parts, when their machinery is sold in quantities, especially when such shipments are to be made to remote points. As an example of such published lists I beg to call your attention to the catalog of this company on diamond core drills. You will find in this instructions for selecting drilling outfits and equipment, and lists with prices of various items of supplies most likely to be needed in a course of prolonged drilling operations. This is an example of a published list.

Competition in a good many lines is too keen to warrant a manufacturer in publishing abroad a list of parts which are likely to "wear out" on his machines. Such a list in the hands of a competitor would prove a useful weapon. Again, if the manufacturer were to recommend that the purchaser buy a long list of repair parts the purchaser's natural impression would be that he is likely to undergo considerable breakage and expense for repairs, and is very likely to place his order with some manufacturer who is less frank and contends that his machinery does not "break down or wear out."

In many cases, at the solicitation of the contractor or other purchaser, we are accustomed to make up such a list of spares as has been referred to by your previous correspondents. In fact, the customer with any familiarity as to machinery and its use usually knows enough to ask for such a list, after the sale has been consummated. The point I am trying to make is that if the purchaser puts it up to the manufacturer at the time the order is placed to furnish suitable supplies of spares for operation over a given period, the manufacturer is only too glad to recommend such a list, because it means an addition to his sale.

S. B. KING,
Sullivan Machinery Company.
Chicago.

Joints in Concrete Roads Laid Late in the Season

SIR: I have read with interest the article on the question of widening the joints of concrete roads laid late in the season, in your issue of Oct. 14, page 465.

The question of the width of joints has been discussed by a number of engineers, some of whom have expressed to me the opinion that they should be wider, especially on work done late in the season. My own opinion in the matter, however, is that the information now at hand is not sufficient to justify any conclusions at this time. The action of pavements where joints are built depends not only on the width of joints, but also on their spacing, and many factors must be considered.

The Illinois Highway Department this past year has constructed a number of stretches of roads without joints. The question to be answered is whether in the long run there is less expense and no greater inconvenience to traffic by leaving out the joints—thus avoiding their first cost of construction and their subsequent maintenance as compared with the maintenance expense that may be incurred on roads where joints have been placed.

These matters undoubtedly will be considered by the road committee of the American Concrete Institute, as well as by the subcommittee on tests for roads of the American Society for Testing Materials.

A. N. JOHNSON,
Consulting Highway Engineer.
Chicago.

Monolithic and Semi-Monolithic Brick Roads Both Satisfactory

SIR: I beg leave to correct certain errors in statement regarding the cement-sand bed construction of brick pavements which were made in the article on monolithic pavements, printed in the Engineering Record of Sept. 30, page 400. The author of the article probably was unacquainted with the history and development of the cement-sand bed type of construction, and erred unwittingly.

The use of the cement-sand bed in lieu of the old sand cushion was not a step in the evolution of the true monolithic pavement. It was a distinct type developed for city streets where the use of a template is not feasible. Its object is not merely to afford a uniform bearing surface for the brick surfacing; the cement-sand bed is converted into a mortar by means of thorough wetting after the brick are laid and rolled but before the grout is applied, and it sets up and effects a union between the brick surfacing and the concrete foundation, thus giving substantially a solid beam from surface to sub-base.

Since the true monolithic construction was perfected and introduced by W. T. Blackburn, consulting engineer of the Dunn Wire-Cut Lug Brick Company, of Conneaut, Ohio, the cement-sand bed type of construction has been known as the semi-monolithic.

So far is the cement-sand bed construction from being unsatisfactory, it is rapidly coming into general use in the large cities. Baltimore and St. Louis, after full investigation and experience, now use it exclusively for brick pavements; and out of fifty-eight streets in Cleveland paved with brick in 1916, not less than fifty-five were of the cement-sand bed type. R. Keith Compton, chairman of the Paving Commission of Baltimore, which city uses a large number of brick annually, says:

"I am more than ever pleased with the mortar (cement-sand) bed, as the superiority of our 1915 work over all previous work on a sand cushion is evident every time one rides over the streets, and I have yet to notice a serious shattering of the top grout in any of the work."

The cement-sand bed construction has stood the test of time. The Thirty-first Street and Thirty-third Street approaches to the Pennsylvania Station, New York, were paved with 2½-in. brick on a cement-sand bed in 1910. These pavements are in fine condition, although over them for six years the average weekly traffic has been about 55,000 vehicles, and a truck-and-wagon tonnage of 31,000,000 lb. exclusive of passenger vehicles.

These figures are based upon a traffic census taken for one week in May, 1916, under average traffic conditions, and reported in the Engineering Record of July 8, page 54.

Bay Street, the heaviest traffic street in Jacksonville, Fla., has a cement-sand bed brick pavement between car tracks several years old, and the pavement is in excellent condition.

These facts were evidently unknown to the writer of the article printed in your issue of Sept. 30, but it seems to me that they effectually establish the fact that the cement-sand bed type of brick pavement is eminently satisfactory for the purpose for which it was designed, namely, a substitute for sand-cushion brick pavements on city streets.

For country highways, the true monolithic brick pavement, as perfected in design and introduced by W. T. Blackburn, is undoubtedly preferable to the cement-sand bed for economical reasons; but engineers are pretty well agreed that each type is highly satisfactory in its proper sphere, and a vast improvement upon the sand-cushion type of brick pavement.

WILLIAM C. PERKINS,
Chief Engineer, Dunn Wire-Cut Lug Brick Company.
Conneaut, Ohio.

How Can Drawings Be Protected Against Dampness?

SIR: The Board of Water Supply of the city of New York will in a short time hang drawings in underground chambers and it will be necessary to protect these drawings from dampness.

Eight or ten years ago a man called with a process for casting drawings in a transparent solid which apparently was neither celluloid nor collodion, although it looked somewhat like both. We had no use for his scheme at the time, but would like very much to try it now, so we would be very glad to hear from any of your readers who have run across this process or a similar one.

The drawings will be in some cases larger than 36 x 48 in. and should be made rigid enough to hang on a wall.

C. F. BELL,
Assistant Engineer in Charge of Drafting, Board of Water Supply.
New York City.

Answers Query as to Grouting Rock Under Ripogenus Dam

SIR: Referring to the letter of H. A. Rands, published in the Engineering Record of Oct. 14 last, the following account of the methods adopted for grouting the rock underlying Ripogenus dam is submitted:

In the core drilling for pressure grouting under this dam (described in the Engineering Record of Sept. 2, page 280) the holes were spaced 6 ft. 8 in. on centers, this apparently arbitrary spacing being adopted to accommodate other conditions. As the air compressor did not arrive until long after the drilling was begun there were quite a number of holes ready for grouting before any was done.

These holes were first tested with a pressure pump and it was found that some showed leaks of much greater magnitude than others. Water under pressure from the regular water supply was then used for thoroughly washing out the holes through a hose run to the bottom, and then applied as a pressure line to the top of each hole. This developed that the holes were not all connected by open seams, but in most cases water was forced out of several holes, and in some cases at quite a distance from point of application. Grout was then applied to those holes which appeared the nearest tight, with the idea of first making these tight, and thus dividing the total space into sections for better treatment.

This having been accomplished, the holes in each section were taken in order and grout applied under 150 lb. air pressure as long as it was possible to force any more into the hole. The last application of air was held on the hole for several minutes to insure the grout being thoroughly driven in, when the hose connection was removed and the pipe capped, as it was found that otherwise the application of pressure to the next hole was liable to drive the grout back out of the one just grouted.

Plugging the cracks penetrated by the various holes required varying amounts of grout, running from 2 to 13 cu. ft. more than the capacity of the drill hole. On the first few applications of grout vents were easily observed in the next holes and for a considerable distance away coming up through the ledge. These gradually subsided until no further escape could be detected, although usually considerably more grout could be forced into the drill hole after this stage was reached. In only one case was any considerable flow of ground water encountered, and this readily yielded to the treatment described and was forced to the surface outside the dam.

For various reasons contingent upon the construction work no test holes have been drilled within the grouted area to ascertain, if possible, the results and effectiveness of the foregoing work, but it seemed to be quite evident that it was at least decidedly beneficial. Experience seemed to indicate that hard ledge with fairly open seams worked much better here than where the seams were filled with softer, crumbling rock or muddy materials.

The rate of drilling is also quite dependent on these same characteristics. This ledge, which is conceded to be one of the hardest, drilled normally in the sounder portions at about 1 ft. per hour with a shot bit, 3 in. in diameter, while a crumbling section or seam would sometimes delay progress for several hours. The amount of shot required was largely determined by the same conditions, but normally from 2 to 3 lb. was consumed per foot drilled in the sounder rock.

E. W. PROUTY,
Resident Engineer, Ripogenus Dam.
Kokadjo, Me.

American Engineers for Canadian Work

SIR: The editorial in your issue of Sept. 23, page 369, with regard to the circular sent out by the Canadian Society of Civil Engineers, has been read with much interest, inasmuch as the writer is a member of the Canadian society on exactly the same basis on which a large number of American engineers have joined that organization.

After an experience of more than fifteen years near the international boundary I have reached the conclusion that the Canadian engineers are very shortsighted in their attitude. A very large percentage of Canadian engineers find employment on the American side and no discrimination is exercised against them, but it is quite the reverse when an American engineer, even though he be a member of their society, desires employment in Canada. There are on my desk at the present time two applications from Canadian engineers for positions, and seldom a week passes that one or two do not drop in looking for employment. Our city engineer here in Seattle is a Canadian, and there are many other engineers in various employments who are Canadians.

Without any idea of retaliation, but simply to demonstrate to our Canadian brethren the injustice of their attitude, it would seem to me desirable that the four large American engineering societies take a census of the Canadian engineers who are employed throughout the United States and settle once and for all this mooted question of nationality.

CHARLES EVAN FOWLER,
Seattle. Consulting Engineer.

Paving Petitions—The Right Kind

SIR: Your editorial of Oct. 14, page 458, entitled "Paving Petitions—The Right Kind," is very timely. It calls attention to a practice which has been prevalent in some communities for a considerable time—that of having a type of pavement selected by petition.

The selection of a pavement involves considerations of such a technical nature that it should be left entirely to the expert. No layman is in a position to advise properly on this matter. Where a selection of particular kinds of pavements is asked for in a petition, it hampers the freedom of judgment of the engineer who makes it his business to know about these things.

It has often happened that people have, owing to the pressure of special interests, petitioned for a type of pavement about which they know very little, and not examining the subject thoroughly, have been led into recommending something which may require the taxpayer to pay heavily for the mistake.

E. W. STERN,
Chief Engineer, in Charge of Highways, Department of Public Works, Borough of Manhattan.
New York City.

SIR: Your editorial on "Paving Petitions—The Right Kind" is extremely pertinent and important.

In a city of several hundred thousand, within 100 miles of New York, I encountered one piece of street with three kinds of pavement in as many blocks. Besides being æsthetically ridiculous, such an arrangement was very hard for horses hauling the heavy loads which went over that street. A horse gets accustomed to a certain type of surface, and I have repeatedly seen one slip so as nearly to fall when a new variety of pavement was encountered.

City charters should invariably leave matters of pavement selection to professional experts. Petitions should ask only for a pavement, the type to be determined by the proper authorities, and after such petition is filed, no opportunity should be given to modify it. This recommendation is known to be drastic, but as soon as it was understood that steps once taken were irretrievable, care would be exercised at the start, which is the proper time.

E. P. GOODRICH,
Consulting Engineer.
New York City.

New California Oil Wells

Sixteen new oil wells were "brought in" in California during the week ended Oct. 21, according to a report by the state oil and gas supervisor. The total number of new wells drilled since Jan. 1, 1916, is 586. A considerable number, however, have been abandoned during this time.

HINTS FOR THE CONTRACTOR

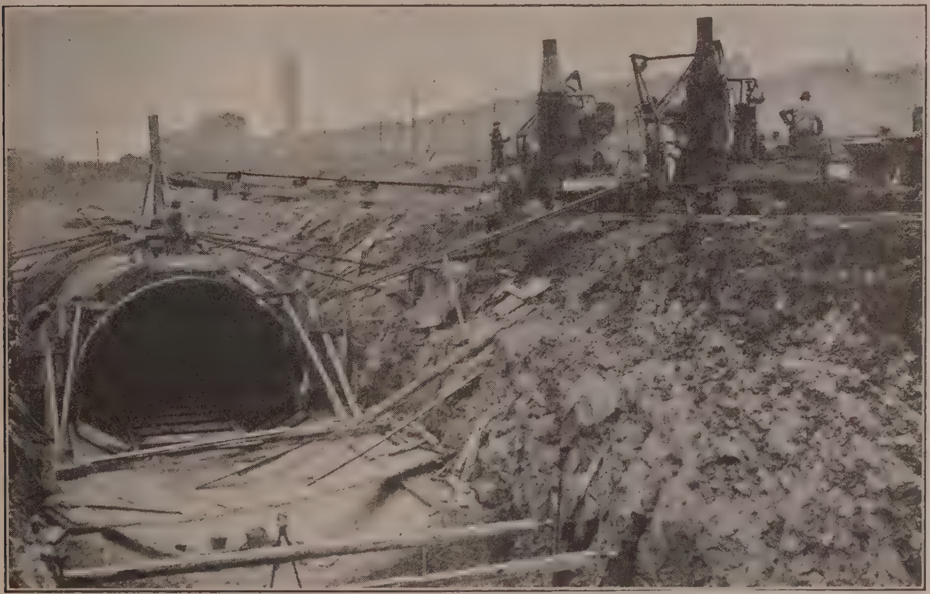
Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Belt Conveyor Deposits Wet Concrete Into Sewer Forms

UNSTABLE banks and a shallow cut which brought the arch of a large sewer in Chicago near the surface gave a slope too flat for spouting and led the contractor to use a belt-conveyor attachment to carry the concrete from the mixer to the forms. The job, Section 4 of the Calumet intercepting sewer system, includes 8700 ft. of trunk sewer near 103d Street and the Pullman Railroad, over which the contractor brings in his supplies. The horseshoe section is 16 ft. 6 in. wide, 13 ft. 2½ in. high and 23 ft. wide over all on the base. The thickness at crown and invert is 18 in. For 3400 ft. the grade makes a very shallow trench, 18 ft., which brings the crown nearly to the ground surface. The remainder will require a trench about 30 ft. deep. The clay is not very stable and some caves have occurred. Therefore a concrete outfit was sought which would not be so heavy as a portable tower plant, but which could deliver over the arch forms into the far side. The belt-conveyor idea, worked out as shown in the photograph, was proposed by W. B. Louer, who sold the contractor the concrete plant.



BELT CONVEYOR DELIVERS CONCRETE HORIZONTALLY INTO SEWER FORMS

The conveyor, which was made by the Weller Manufacturing Company, is 30 ft. long, but the wooden frame can be extended to any length desired. The inner end is supported by a series of overhanging channels bolted to the mixer platform. Supporting the outer end are uprights carried by a small car running over a 24-in. gage track laid on the finished work at the back end and at the forward end over the steel forms. The uprights are bored to permit raising and lowering the end of the conveyor. Three 18-ft. sections of this track are provided. The belt is gear driven from the countershaft of the mixer and discharges onto a flipflop, which directs the concrete to either side of the crown. When the concrete nears the top of the forms two men are employed to spread it. The invert is placed in advance of this work by a second mixer through a 30-ft. chute.

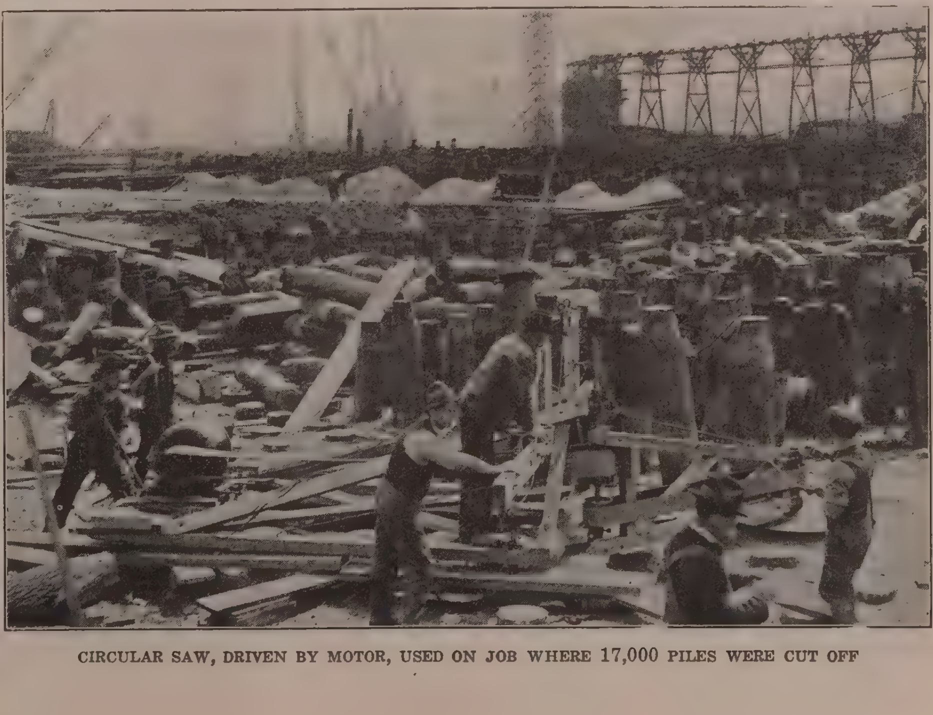
Material is supplied to this plant from a siding at one end of the 3400-ft. section, where elevated bottom-discharge bins of 300-yd. capacity have been erected over a narrow-gage track. Cars are unloaded into the bins by a derrick car operating a ¾-yd. Owen bucket. Along the narrow track, but between it and the standard-gage siding, is the cement shed holding four carloads. Batches are proportioned at the siding. The contractor has four horse-drawn six-car trains of 1-yd. Koppel cars, with gage marks for broken stone and sand. After loading with the latter the cars are pulled opposite the cement shed, in the side of which are six tilting chutes, on each of which may be emptied two sacks of cement.

At the sewer the standard-gage track on which the mixers run is 33 ft. from the center line of the sewer. The narrow-gage material track is 7 ft. farther away to enable the cars to dump directly into the loader, which was specially built low and wide to permit the cars to dump clean without raking. The two Chain Belt mixers, which have reversible traction and flanged car wheels, are attended by push cars carrying coal and water. Five 25-ft. sections of Blaw steel forms are used. To facilitate setting the forms and aligning them the concrete is brought up 4 or 5 in. above the invert at the sides.

The Calumet intercepter system is being built by the Sanitary District of Chicago, for which George M. Wisner is chief engineer. The design and construction are under the immediate charge of Langdon Pearse, assistant engineer, assisted by R. H. Burke. J. P. Gallagher is resident engineer and Nash Brothers are the contractors.

Portable Motor-Driven Saw Cuts Off Wood Piles

ONE of the methods devised to cut to grade the 17,000 piles under the 6,000,000-bu. grain elevator being built for the Chicago & North Western Railway Company in Chicago, and described on page 567, is shown in the photograph herewith. The motor drives a vertical countershaft which carries a swinging boom on the outer end



CIRCULAR SAW, DRIVEN BY MOTOR, USED ON JOB WHERE 17,000 PILES WERE CUT OFF of which is mounted the saw. The saw is held against the piles by two men with holding rods. To get an even bearing a plank track was laid over boards placed diagonally on top of the piles, which had already been cut off.

The contractors on this work were the Witherspoon-Englar Company and Grant Smith & Company, Chicago.

Tubing Wound on Reel Without Detaching—No Couplers Used

By W. H. HYDE
Contractor, Pittsburgh, Pa.

IN DRIVING two tunnels through a rock fault in the mine of the White Oak Fuel Company, Whipple, W. Va., an unusual method of using tubing is employed. To keep a circulation of fresh air at the face, remove rock dust while drilling and the smoke after shooting, 8-in. Flexoid tubing is wound and unwound on a drum before and after the shot is fired. Just before shooting, the fan is shut down and the tubing collapses flat. Two men put a drill through a center hole in a light wooden drum, making a reel, and wind up the tubing without detaching it. After the shot, they run up to the face, reeling off the hose as they go. The first sections of the tubing have been in daily and nightly use for five weeks and are still performing their duty satisfactorily.

Instead of using couplers, which are awkward on the reel, the ends of the sections are telescoped in the direction of the air current, sewed with fine wire and covered with a short section of the tubing. In each case the tubing is coupled to a Buffalo No. 3 volume blower direct-connected to a 3-hp. Peerless electric motor. These blowers are set in the main entries adjacent to the tunnels. The tubing extends around a corner, along the floor of the tunnel; near the face the end is raised and hung so that it points to the roof close to the face of the heading. This arrangement seems to work best for clearing the face of the rock dust while drilling.

The tunnels are 6 ft. high, 10 ft. wide and 400 ft. long. The drilling of the hard fine grained sandstone is done with Jackhamer drills. The dynamite used is of the 60-per cent gelatin grade. An unusual amount of dust is present because of the dry nature of the rock.

Derrick Chair Takes Superintendent with Broken Leg to Work

THAT there are ways to get around over a subway job even with a broken leg was proved a short time ago by John T. Prior, superintendent for Smith, Hauser & Macisaac, Inc., of the section of the subway under William Street, New York City, which that firm is building. The superintendent's office, on the second floor of one of the shaft houses, and the construction work underground would seem to be safe from invasion by a man with a broken leg.

CHAIR TAKES INJURED SUPERINTENDENT TO SECOND-STORY OFFICE

Not to be kept at home by a plaster cast, however, when he was needed at the work, Mr. Prior had a chair built in which the shaft derrick could hoist him from the street to his office.

Ordinary Valve Used as Shock Absorber in Pump Discharge

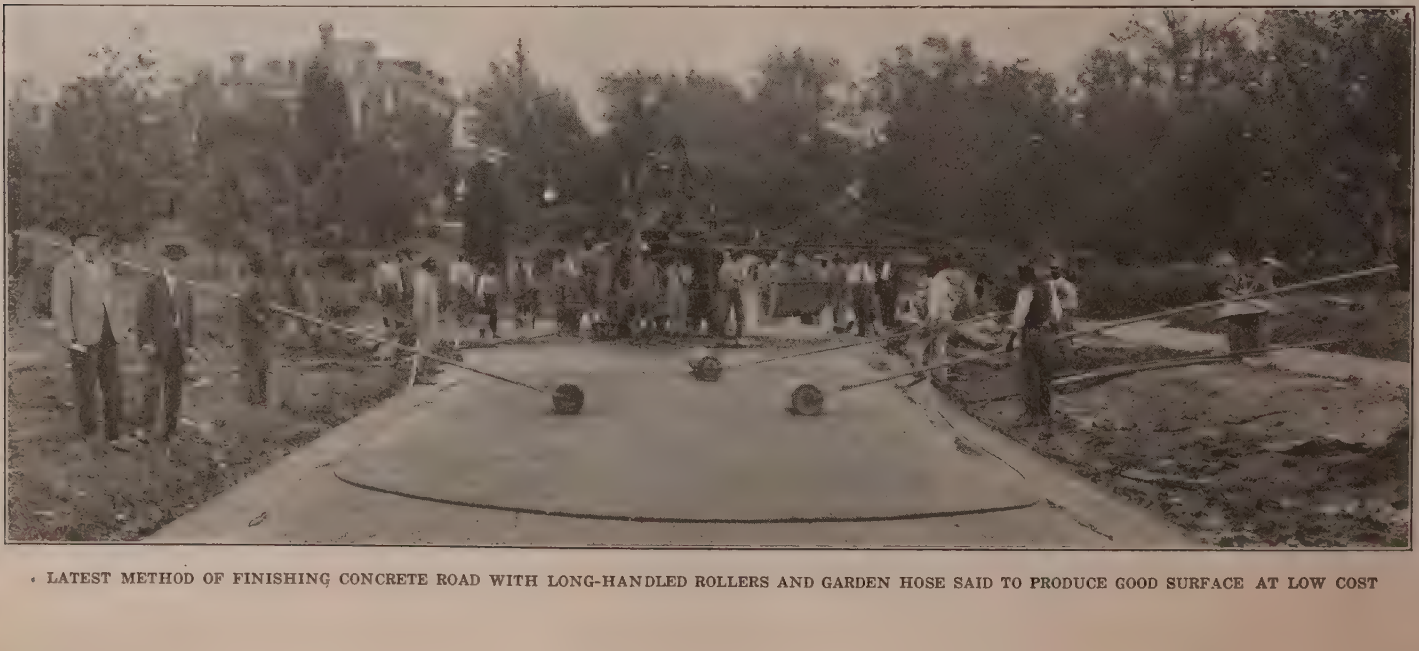
By GEORGE W. McALPIN
New Richmond, Ohio

PRESSURE release for the discharge line of the piston pump supplying water to one of the concrete mixers in use at the government dam under construction at New Richmond, Ohio, was provided by inserting a T in the line, to which a nipple, a valve and a short length of vertical pipe were fitted. The pump ran continuously, while the discharge line would often be shut off abruptly at the mixer. The back pressure produced in this way was bad for the pump, and to relieve it the outlet was put in.

To maintain a constant pressure, which would keep the pump running at constant speed, a plain piece of pipe reaching just above the elevation of the discharge at the mixer might have been used, but would not have been convenient. The same result, however, was accomplished by putting in a shorter piece of pipe with the valve and partly closing the valve until it required a little more pressure to force water out of the relief pipe than to raise water to the mixer. The "shock absorber" in this case was made of 1½-in. pipe and valve, and was in a discharge line of the same size from a 5 x 3½ x 6-in. pump. The valve was adjusted so that no water was forced out of the vertical pipe when the discharge line was open.

Use Rubber Hose to Finish Concrete Road

IN FINISHING the surface of a concrete road in Myers Park, Charlotte, N. C., W. C. Campbell, of the Hardaway Contracting Company, of Columbus, Ga., used long-handled rollers and rubber hose. The photograph shows how the work was done. The hose was 1 in. in diameter, rubber on woven fabric, while the rollers were made of wood covered with 24-gage steel sheets. It is claimed that labor costs have been reduced by employing this equipment.



LATEST METHOD OF FINISHING CONCRETE ROAD WITH LONG-HANDLED ROLLERS AND GARDEN HOSE SAID TO PRODUCE GOOD SURFACE AT LOW COST

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Lump-Sum Contract Not Favored by Texas Society

"Cost Plus" System Preferred—Tentative Engineer's License Bill Will Be Drawn Up—Officers Elected

The annual convention of the Texas Association of Civil Engineers was held in Dallas Oct. 20 and 21 with about fifty members present. The opening address was given by President C. H. Chamberlin, chief engineer of the Texas & Pacific Railway, who indulged in reminiscences, beginning with his entrance into the engineering field in 1881. He also pointed out the great progress made in civil engineering in the South during the last 30 years. Then followed discussions of the Texas cement industry, lump-sum contracts and an engineer's license law.

During a general discussion it was pointed out that although the five cement mills in Texas produce 3,750,000 bbl. annually, and Texas uses 2,500,000 bbl., only 2,000,000 bbl. used in the state were produced by the Texas companies. The matter was referred to the board of direction for investigation.

Want Lump-Sum Contract Abolished

John B. Hawley, of Fort Worth, summarized the work of the Texas division of the National Industrial Preparedness Board. F. A. Jones emphasized the great service rendered by the engineers of the country in a work to which they unselfishly gave their time and more than a quarter of a million dollars. Mr. Jones also presented a paper on the "Honor System in Contracting," in which he strongly advocated the "cost plus" system. As reasons for his attitude he cited cases from his experience of fifteen years with both forms of contracting. The general sentiment of the meeting seemed to be for abolishing the lump-sum system.

The first paper of the afternoon session was "Engineering Human Problems," by E. B. Gore, of the Texas board of water engineers. He mentioned the engineering problems connected with irrigation on the lower Rio Grande River, calling attention to the difficulties of seepage and silt-deposit prevention. He was of the opinion that these problems were simple when compared with those of preventing water waste by the settlers.

E. C. Woodward, of the Dallas City engineering department, presented a paper on "Building the Maintenance Into the Pavement." C. R. Chamlin, of the Trinity Portland Cement Company, discussed "Concrete as Specified and as Laid." The last paper read was by J. B. Hawley, on "Notes on Sewer Construction."

The following officers were elected: J. H. Howe of Houston, president; R. C. Gowdy of Fort Worth and R. J. Potts of Waco, vice-presidents.

Will Prepare Tentative License Bill

After the banquet at the Oriental Hotel the advisability of putting through the engineer's license bill at the next legislature was discussed with keen interest. While the general sentiment of the association seemed to be that some sort of regulation was required, no definite agreement was reached as to just what form it should take. A tentative bill will be submitted to the members for a letter vote. If approved, the committee will take the bill to Austin with power to alter it in any way it sees fit in order to get it through the legislature.

Wall Collapses—Four Boston Buildings Wrecked

Structure Being Remodeled—Wall Had Been Reported Unsafe—Cause a Mystery, Although Explosion Is Suggested

Four buildings in Portland Street, Boston, were reduced to a mass of wreckage the night of Oct. 26 when a wall collapsed in one of the two structures being remodeled. Several weeks ago a complaint had been filed with the building department that the wall in question was "too thin, unsafe and a menace." A report from the inspector, however, stated that there was no danger of collapse.

Twin Six-Story Buildings Fail

The building, a twin six-story affair, was numbered 21-29 and 31-39 Portland Street. The front and rear walls had been removed and a new concrete foundation laid. A wall in the building numbered 21-29 is believed to have caused the collapse. The entire framework of this structure, in which were two heavy iron beams, crashed against its twin structure numbered 31-39 and wrecked it.

The six-story wall was flung across an areaway in front of No. 19 Portland Street and pounded into the center of the northerly wall of the three-story brick building at No. 17 Portland Street. The impact crushed the second floor of the structure and it crumpled.

The cause of the accident has not been definitely determined at this writing, although an explosion is said to have caused the wall to collapse.

Waterworks Men Gather Nov. 15 at Wilmington, Del.

The next meeting of the "four-state" section of the American Waterworks Association will be held Nov. 15 at Wilmington, Del., in the Hotel DuPont. The morning will be devoted to an inspection of the new reservoir and filtration plant now under construction. A short business session will be held in the afternoon.

The "four-state" section includes southern New Jersey, Delaware, Maryland and eastern Pennsylvania.

Railroad Inquiry to Begin November 20

The joint congressional inquiry into the general railroad situation is scheduled to begin Nov. 20 at Washington, D. C. The resolution under which the investigation is to be held calls for a report to Congress not later than the second Monday in January. Senator Newlands, chairman of the committee, states that the committee desires to give ample opportunity to all interested to express their views, but would like early notice of the subjects to be discussed, so that there may be an orderly sequence of subjects.

Road Congress Dec. 7 at Chicago

The Northwestern Road Congress will hold its third annual meeting Dec. 7 and 8 at the Hotel Sherman, Chicago. Among the papers to be presented is one by W. D. Uhler, chief engineer, Pennsylvania Highway Commission, on handling state maintenance problems, and another by Logan Waller Page, director, U. S. Office of Public Roads and Rural Engineering, on "Federal Participation in Road Work."

Prices of Materials—Page 181

Report Radical Advances in Water Sterilization

Engineers at American Public Health Association Convention Discuss Sanitary Problems of Water, Sewage and Garbage

Activated sludge results, river cleaning, sterilization of water with chlorine and ammonia, color removal and a discussion of garbage specifications were the more important topics discussed by the sanitary engineering section of the American Public Health Association at its annual convention in Cincinnati, Oct. 25, 26 and 27.

The officers of this section elected for next year are: Theodore Horton, chairman; George S. Webster, vice-chairman; H. D. Pease, secretary; and Paul Hansen, associate secretary. For the laboratory section Dr. Henry Albert was made chairman and Dr. Charles Krumwiede, secretary. Dr. W. A. Evans was elected president of the association and Selskar M. Gunn was retained as secretary.

Water Sterilization

Capt. Joseph Race, city bacteriologist, of Ottawa, gave information relative to improved sterilization methods using 0.23 part per million of available chlorine from bleach and 0.12 part of anhydrous ammonia. The chloramine formed is not consumed nearly so fast as chlorine, hence less is required. The process becomes economical when the price of hypochlorite exceeds about 2 cents per pound, and ammonia containing about 10 per cent NH_3 can be purchased for 2½ cents per pound. One precaution is to introduce the ammonia a minimum of time before introduction into the water supply. The process has worked out satisfactorily in swimming-pool sterilization, where bleach treatment could not be used on account of the large amounts required.

The water, sewage and garbage plants in Cincinnati were described by J. W. Ellms, W. E. Sullivan and W. C. Folsom, respectively. H. W. Streeter and W. C. Purdy, of the Public Health Service, gave reports on the investigation of the pollution of the Ohio River which the service has been carrying out.

In discussing the report of F. F. Longley on water supply, W. L. Stevenson, of Philadelphia, stated that he has been using liquid chlorine and lime to make a bleach solution for sterilizing sewage filter effluents. The amounts employed were 6 lb. and 8 lb. respectively, to 1,000,000 gal.

Relative to dual water connections Paul Hansen said Rockford, Ill., had a sad experience—10,000 cases of enteritis and many cases of typhoid. In Philadelphia all dual connections have been ordered out.

Rapid Filter Sludge a Problem

The problem of the disposal of sludge from mechanical filters followed R. W. Pratt's paper on the Cleveland water purification plant. W. H. Dittoe said the removal would be necessary if discharged into the river bed. He also cited a case at Columbus where from 1 to 2 ft. of sludge had accumulated in the river below the filter plant for a distance of a mile or more. The State Board of Health had made requirements at Cleveland for drying the sludge and it could be drained to 98 per cent moisture and then shoveled and dumped. The discharge of such sludge may become a nuisance as important as a question of sewage disposal. The question of the disposal of wash water is less important. Theodore Horton stated that on the Niagara River there were two plants at Niagara Falls, one of which was located above the other and discharged the sludge into the intake of the lower works. No serious results had occurred. A uniform discharge was desired. It was considered legitimate in his opinion to return wash water to a stream or lake from which the supply was taken and the sanitary question involved was of no importance.

The question was brought up as to the effect of wash water on city sewers and their maintenance. Mr. Stevenson stated that at Philadelphia the upper Roxborough filter discharged through a small drain to an intercepting sewer and that the fine sand which was carried over required constant maintenance of the sewer.

Color Removal Hard

"Colloidal Chemistry in the Removal of Color and Turbidity from Water," a paper by George F. Catlett, defined the nature of color and turbidity. He said that it was generally agreed that aluminum sulphate was the best means of removing color. He briefly reviewed Professor Whipple's paper of several years before on color removal and added that the use of an excess of alum dosed into part of the supply, the dosed waters then being mixed with the rest of the water, was very successful. This has been applied in Massachusetts at Springfield and also at Wilmington—at the latter place by adding the excess in one basin (see Engineering Record, June 3, 1916, page 741). Acid helps in the removal of lead acetate or tannin. Colloidal precipitation is thereby produced and an alkalinity of 9 parts per milion may be neutralized with a color of 250 and the color removed. The use of 6 gr. per gallon of alumina sulphate in such a case may not be sufficient for complete precipitation of the color. Apparently the basic salt worked better than salt containing hydrate. Some alkalinity should be present but not enough to neutralize all the aluminum sulphate.

Professor Whipple commented on the fact that the electrical charge of the color may be either positive or negative. The addition of carbonic acid may intensify the action or even reverse it.

Captain Race stated that the Ottawa River water had been experimented upon in bottles and that 40 p.p.m. of color could be removed with a good floc when alum was added in just sufficient amount to react with the alkalinity. In his opinion the color removal was due to the coagulation of negative particles of color. An alkalinity of 24 was reduced to 12. Less alum may be required if the alkalinity is reduced to 0. In Ottawa if the color is high an excess of alum is required, but if the addition of alum is not sufficient to reduce the isoelectric tension to zero, the excess has no value. Aeration promotes coagulation.

Fewer Water Analyses Recommended

In his paper on "Fallacies in the Investigation of Water Supplies," H. A. Whittaker pointed out that it is important to include in the routine of a state board of health the personal inspection of all water supplies passed upon. In Minnesota for fifteen years such field surveys have been required. Sampling equipment is not provided for local authorities despite their criticism. A table submitted indicated that unless field inspection was made, there is a chance for 40 per cent of doubtful analyses to be approved. In the discussion it was brought out that the sources of pollution might be obscure and that consequently analytical results are valuable to check up.

Mr. Hansen pointed out that in the past a great deal of useless analytical work has been done on account of popular demand. In New York Mr. Horton stated that the inspection of the ground was always required. The laboratory analysis, in his opinion, had less value than a good sanitary survey. The survey has materially reduced the number of analyses and instead of making one a month, as was done in Massachusetts, Mr. Horton makes four analyses a year and recommends a yearly field examination.

Harrison P. Eddy, chairman of the committee on sanitary control of waterways, summed up progress and pointed to the need of economy and the distribution of equities on a scientific basis. There should be no nuisance in the stream, neither should disease be spread. The removal of floating matter is important and at times the settling suspended solids in river cleaning is very important.

After George W. Fuller had stated that the report contained nothing to which exception might be taken, Mr. Hansen suggested that he was adhering to the belief that the courts are the best method of adjustment as to the relation of sewage treatment, water supply and the like. He held that stream pollution has a comparatively small effect on the public health. Mr. Messer stated that in Virginia the problem of the oyster beds and industrial pollution was raising the question of the adjustment of values.

A paper on "The International Joint Commission and Pollution of Boundary Waters" was read by Prof. Earle B. Phelps. The discussion brought out the need of a balance between water supply and sewage. The analysis of the fact should be carefully considered with due attention to all equities and an authority should be present to enforce a decision.

The report of the committee on sewerage works operation was read by W. L. Stevenson, who stated that in his opinion a general blank could not be prepared that was applicable to all cases.

The reports of the three committees are to be printed and left open for adoption at the next meeting.

R. W. Pratt's paper on "Activated Sludge Work at Cleveland" was short, giving much valuable data resulting from experience with the operation of a plant having an aeration capacity for 1,000,000 gal. per day and a settling capacity for 500,000 gal. per day. A reasonably stable effluent was produced with ¾ cu. ft. of air per gallon of sewage and 2 hours' aeration, using 25 per cent of activated sludge. The temperature was stated to have little or no effect. A number of attempts to prevent the sludge from decomposing and smelling had been tried out, but no final results had been attained. With electric current at ¾ cent per kilowat-hour the power cost for air amounted to $7.50 per 1,000,000 gal. of sewage. The labor cost at the Cleveland plant amounted to $15 per 1,000,000 gal., but could probably be reduced for larger units.

The annual report of the committee on refuse collection and disposal by S. A. Greeley, chairman, was limited to a review of events of particular interest during the past year in the line of sanitary engineering work. The committee report was amplified by papers presented by Rudolph Hering and William F. Morse.

Wants Saner Refuse Plant Specifications

Dr. Hering's paper on contract plans and specifications for refuse incinerators pointed out clearly the extremes found in present practice. On the one hand were the carefully worded specifications requiring extreme guarantees on the part of the contractor. These specifications, because of the guarantee required, resulted in two court cases. At the other extreme are a large number of garbage furnaces and refuse incinerators which are purchased under almost no specifications at all. In these cases the lack of attention to details during construction has resulted at times in unsatisfactory operation. It was suggested that more attention should be given by city engineers to the preparation of plans and specifications for construction, thus securing better work and relieving the contractor in part from the burden of extreme requirements of the guarantees. In addition, the paper called attention to the need for considering the refuse problem as a whole, including the house treatment and collection as well as the disposal.

The paper by Colonel Morse included a compilation of statistics resulting from inquiries to 201 cities and towns relating to the practice and cost of refuse collection and disposal. The organization of departments in the work, the methods used and cost figures were tabulated and summarized.

A report by the committee on street cleaning, of which S. Whinery was chairman, went into considerable detail regarding the effect of street-cleaning work on the health of men engaged in street cleaning and also on the health of those living in the neighborhood of dumps or other centers of activity of street-cleaning work.

California Railroad Commission Declines to Investigate Terminal Questions

The Railroad Commission of California recently decided that it has jurisdiction within the city of Los Angeles over the construction of union passenger and freight railroad terminals, over the elimination of grade crossings and the safety of such crossings. The commission declined, however, to make an investigation into these matters or to formulate a general plan for them, and has ordered the inquiry carried out by the railroads and the city of Los Angeles, unless the commission is otherwise directed by the Supreme Court of California.

This decision was rendered in a consolidated proceeding against the Southern Pacific Company, the Atchison, Topeka & Santa Fé and the San Pedro, Los Angeles & Salt Lake railroads, undertaken as a result of seven complaints filed with the commission by the Municipal League, the Central Development Association and the Civic Center Association, all of Los Angeles and the cities of Pasadena, Alhambra, San Gabriel and South Pasadena. The complainants asked that the railroads be directed to construct a union passenger and freight station in Los Angeles. They also asked the commission to direct the railroads to reconstruct their tracks running to and from this terminal station so as to eliminate grade crossings.

New England Waterworks Men Meet November 8 in Boston

The November meeting of the New England Waterworks Association will be held next Wednesday at the Hotel Brunswick, Boston. The executive committee will hold a session in the morning. The afternoon will be devoted to discussion of F. A. Barbour's paper, which was postponed from the Portland convention, the report of the committee on meter rates, water loss by leakage and non-registration of meters. S. A. Agnew, superintendent of the Scituate (Mass.) Water Company, will give an illustrated lecture.

The nominating committee, at its Oct. 21 conference, prepared the following list of nominations: President, Caleb Mills Saville; vice-presidents, C. E. Davis, S. E. Killam, H. V. Macksey, F. A. Barbour, P. R. Sanders and Thomas McKenzie. Willard Kent is nominated for secretary and Lewis M. Bancroft for treasurer.

Select Nominees for Offices in Civil Engineering Society

The list of nominees for offices in the American Society of Civil Engineers as it will be presented at the annual meeting Jan. 17, 1917, is as follows: President, George H. Pegram, chief engineer, Interborough Rapid Transit Company and Rapid Transit Subway Construction Company, New York City; vice-presidents, George W. Kittredge, chief engineer, New York Central Railroad, New York City, and George S. Webster, director, Department of Wharves, Docks and Ferries, Philadelphia; treasurer, George W. Tillson, consulting engineer to borough president, Borough of Brooklyn, New York City. Alfred D. Flinn and Lewis D. Rights of New York City, William R. Hill of Albany, Arthur P. Davis of Washington, W. L. Darling of St. Paul and R. H. Thomson of Seattle are the nominees for directors of districts 1, 3, 5, 7 and 12 respectively.

Announce Tentative Valuations of Two Railroads

Tentative valuations of two railroads have just been submitted by the Interstate Commerce Commission in connection with the federal valuation of the carriers. The two railroads are the Atlanta, Birmingham & Atlantic and the Texas Midland. The former, with a mileage of 634 and a capitalization of $54,571,176, is given a reproduction cost new of $24,154,998, and a reproduction cost less depreciation of $19,408,810, the figures being exclusive of land, which is valued at $2,291,413. The Texas Midland, with a mileage of 111 and a capitalization of $2,112,000, is given a reproduction cost new, excluding land, of $3,382,004, and a reproduction cost less depreciation of $2,527,417. Lands used for transportation purposes are valued at $236,690.

Original cost is not reported complete for either road. For the Atlanta, Birmingham & Atlantic it is dismissed with the statement that "original cost of property could not be found." In the case of the Texas Midland it is stated that the result of an attempt to show the original cost to date of each piece of property has not been satisfactory, and that a statement would be entirely misleading. Figures are given for the original cost of equipment and of land.

Nothing is allowed either property for other values or elements of value. Even development expenses are apparently denied, and no mention is made of contingencies.

The reports are addressed to the U. S. attorney general, to the governors and public service commissions of the states in which the properties are located and to the railroads. They are required to file any protests within thirty days from Nov. 1.

What Engineers and Contractors Are Doing

WILLIAM A. DUFF, formerly engineer of bridges for the Canadian Government Railways, at Moncton, N. B., has been appointed assistant chief engineer. He will continue to discharge his duties as bridge engineer and will have charge of the Halifax ocean terminals.

LEWIS WARRINGTON BALDWIN, formerly general manager, and who was recently made vice-president of the Central of Georgia Railway, obtained his first experience in the engineering department of the Illinois Central Railroad. He was graduated from Lehigh University in 1896, in which year he entered the employ of the Illinois Central as chainman. His advancement was rapid and at the time of his resignation in November, 1915, he was general superintendent of that road's southern lines. Mr. Baldwin left the Illinois Central last year to go to the Central of Georgia as general manager.

GEORGE D. BROOKE was recently made superintendent of the Cumberland division of the Baltimore & Ohio Railroad. Two years after graduation from the Virginia Military Institute in 1900, Mr. Brooke entered the engineering department of the Baltimore & Ohio. He had risen to the grade of assistant engineer in 1904. In 1911 he was made assistant engineer in charge of the operating department and a year later was appointed superintendent of the Shenandoah division. At the time of his recent promotion Mr. Brooke was superintendent of the Ohio division.

HARRY O. COLE, who became associated with the Guggenheim interests last month as assistant engineer, has been made assistant construction engineer. Mr. Cole will have his headquarters in New York City, as before.

SYDNEY B. WILLIAMSON, who resigned early this year as chief of construction for the U. S. Reclamation Service to become chief of the field forces of the Guggenheim interests, has been made construction engineer. He will continue with headquarters in New York City.

CHARLES JOSEPH CARROLL, civil engineer, of Towanda, Pa., has been appointed assistant chief engineer of the railway to be built in China by the Siems-Carey Railway and Canal Company. Mr. Carroll has been engaged in engineering practice since graduation from Yale University in 1899, when he entered the service of the Mexican International Railroad. He was made assistant chief engineer of that road in 1906 from which position he resigned in 1907. For three years he practised consulting engineering at the end of which period he was appointed superintendent of construction for F. V. Lister & Company on the National Railway of Mexico. He resigned in 1911 to again engage in private practice.

R. E. ANTHONY has left the employ of the Bethlehem Steel Company, where he was transitman on the plant enlargement at Steelton, Pa. He is now with the New Jersey Zinc Company of Pennsylvania, with office at Palmerton, Pa.

GARVIN N. HOUSTON, consulting engineer, has reopened his office in the Equitable Building, Denver.

CHARLES G. THOMAS, formerly assistant on the engineer corps of the valuation department of the Pennsylvania lines west of Pittsburgh, has resigned to take a position with the Niagara Alkali Company of Niagara Falls, N. Y.

GARFIELD STUBBLEFIELD, consulting engineer, of Portland, Ore., is at Ontario, Ore., where he is engaged on preliminary engineering work for an $80,000 drainage district. It is proposed to use tile and treated concrete pipe instead of open drains.

C. P. COLLINS has resigned as sanitary engineer of Johnstown, Pa. He has announced no plans for the future. The sanitary work will be handled by J. R. Crissey, city engineer, until the services of another sanitary engineer can be secured.

JARED BOGARDUS, formerly assistant engineer on the Catskill Aqueduct, is now in Chile with the Braden Copper Company. He is located in a surveying camp in the Andes 100 miles southeast of Santiago, where he has had an opportunity of watching snow slides in midsummer.

L. W. HUTCHINSON has left the service of the Pennsylvania Railroad to join the engineering forces of the H. Koppers Company, with headquarters at Steubenville, Ohio.

HYNDMAN IRWIN, formerly editor of the *Canadian Engineer*, has sailed for England with a draft of the Canadian artillery. Mr. Irwin joined the staff of that journal in 1913, resigning early this year to enter the officers' training school at Toronto. He was graduated from the University of Toronto, class of 1909, after which he took a post-graduate course in civil engineering. He spent a year in the Great Northern Railway shops at Havre, Mont., and was subsequently power engineer for the Cottonwood Coal Company at Belt, and Stockett, Mont. He was also at one time power engineer for the Graves, Bigwood Lumber Company, at Byng Inlet, Ont.

CHARLES REED MARSH has resigned as superintendent of construction, U. S. Public Buildings, to become engineering assistant to the municipal architect of the District of Columbia. He will have charge of repairs and improvements of all municipal buildings in Washington. Mr. Marsh received his engineering education at the University of Pennsylvania and Cornell University. After a short experience with the Harris Engineering Company and Dodge & Day of Philadelphia, Mr. Marsh entered the service of the U. S. War Department as engineer and superintendent of construction in the quartermaster's department. Since early in 1911 he held the position from which he recently resigned.

ISAAC S. WALKER recently resigned as assistant engineer for Hering & Gregory, consulting engineers, of New York City, to take a position in the Bureau of Surveys of Philadelphia as assistant engineer in the Sewage Disposal Division. During the 6½ years Mr. Walker was associated with Hering & Fuller and Hering & Gregory he was engaged in the preparation of reports and plans for filtration, sewage-treatment, and refuse-disposal plants. Prior to that he was for nine years with the Philadelphia bureau of filtration on construction. For the last two years Mr. Walker has conducted evening classes in sanitary design at Columbia University. In his new position he has charge of the preparation of plans for the collection, treatment and disposal of sewage. He will report to W. L. Stevenson.

F. C. SCHUBERT, U. S. assistant engineer, Portland, Ore., and E. B. Clark, chief clerk of the Portland U. S. engineer's office, recently completed a tour of inspection of the Snake and Clearwater Rivers in the Lewiston, Idaho, district. A preliminary report is to be made relative to needed improvements, especially on the Snake River. It is intended to construct dams for the generation of electricity and make the Snake River navigable throughout the year.

C. W. WILEY, vice-president and general manager of the Seattle Construction & Dry Dock Company since it was taken over several months ago by the Todd interests, of New York City, has been elected president of the corporation, succeeding W. H. Todd, who becomes chairman of the board.

VICTOR CARLSON, contractor of Portland, Ore., who recently completed several large building contracts in Butte, Mont., has returned to Portland to re-engage in the construction business.

Obituary Notes

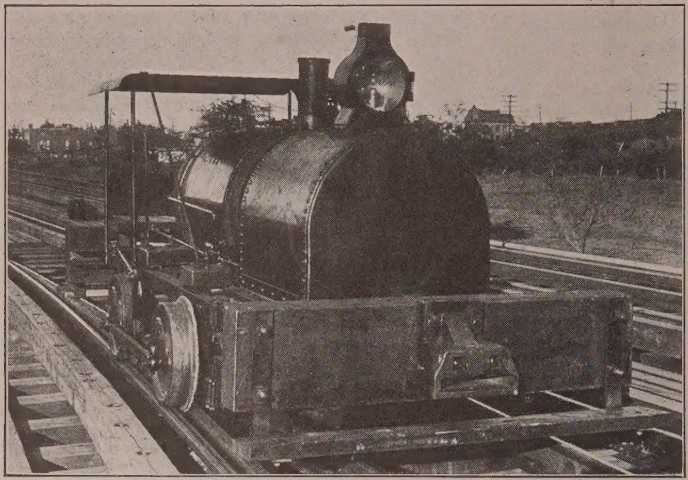
THEODORE N. ELY, who retired from active work in 1911 as chief of motive power of the Pennsylvania Railroad, died Oct. 28 at his home in Philadelphia. He was born in Watertown, N. Y., in 1846 and was graduated from Rensselaer Polytechnic Institute twenty years later. Soon thereafter he entered the service of the Pittsburgh, Fort Wayne & Chicago Railway as a member of its engineer corps. In 1869 he was made division superintendent for the Pennsylvania Railroad and the next year assistant general superintendent. His appointment as chief of motive power came in 1893 after many rapid promotions.

CHARLES W. HOTCHKISS, president of the Chicago Tunnel Company, and well known in railroad circles, is dead at Battle Creek, Mich. He was born in 1863 at Unadilla Forks, N. Y. His first railroad work in 1881 on the New York, West Shore & Buffalo Railroad was followed five years later by his appointment as assistant engineer for the Michigan Central Railroad. After 10 years with that line Mr. Hotchkiss resigned to become chief engineer of the Chicago Junction Railway, which position he held for two years. His appointment as chief engineer of the Chicago Transfer & Clearing Company preceded his election to the presidency of the Indiana Harbor Railroad by only a year. From 1906 until 1912 Mr. Hotchkiss was general manager of the Chicago, Indiana & Southern and the Indiana Harbor Belt railroads. Since the latter year he had been president of the Chicago Tunnel Company. He went to New York City in 1912 to become president of the Rail Joint Company of America and associated with various Staten Island properties. Mr. Hotchkiss was a well-known member of many engineering societies and a pioneer in the development of transportation in northern Indiana.

New Locomotive Is Light and Strong—Standard Design

A new type standardized steam locomotive has been designed by the Bell Locomotive Works, New York City. The machinery or engine parts are all confined to one unit so small and compact that it can be installed in the narrowest gage locomotive. In the new machines the designers have striven to perfect a locomotive that could be built in several sizes without extensive alterations to the power plant, that would burn all kinds of cheap fuel without emitting smoke and sparks and could be made narrow, short and low.

The engine unit is fitted with roller bearings and drop-forged parts. Oil-tight dust-proof cases inclose all working parts. The boiler is of the horizontal type, with shell and firebox head of one piece of pressed steel and smokebox head welded in. The shell is wound with several layers of piano wire to give it great strength without excessive weight. The tubes are expanded into the front and brazed into the rear head from the inside of the boiler by a patented process.



NEW LOCOMOTIVE DESIGNED FOR MAXIMUM COMPACTNESS AND FOR OPERATION ON CHEAP FUEL WITH NO SMOKE OR SPARKS. BUILT IN SIZES FROM 2 TO 14 TONS OR LARGER.

The fire is so distributed that it gives maximum heat to the lower tubes and only a comparatively low heat to the tubes above the center of the boiler, which are not under water. No stays, seams, or rivets are used. The boiler plant is easily cleaned and so designed that all the tubes may be removed and replaced in one unit, when necessary, in from one to two hours' time. A steam pressure of from 300 to 350 lb. is carried, at which the factor of safety is at least 10. The boiler may be fired from cold in 10 to 30 minutes, or instantly after a one or two hours' stand.

These features, say the manufacturers, give a locomotive that will run on any fuel—gasoline and kerosene to crude oil, coal or wood. The machine has the speed of the direct-connected combined with the power of the geared locomotive. These locomotives can now be built in sizes from 2 to 14 tons.

Form First Co-operative Company to Export Lumber

The formation of the first organization for co-operative selling to enable an American industry to compete with foreigners in foreign markets was recently announced by the Bureau of Foreign and Domestic Commerce. The organization is an export sales company, representing 80 per cent of the Douglas fir cut in this country. The bureau thinks that it will give American lumber a decided advantage in the trade struggle that will follow the war.

A statement issued by the bureau says: "It is expected without violating the present anti-trust law to give American manufacturers some of the advantages that were hoped for from the Webb bill, which the last Congress failed to pass."

Open New Waterworks Department

Everything that may be required in the line of waterworks supplies, except cast-iron pipe and meters, is now offered by the newly organized waterworks supply department of the Modern Iron Works, Quincy, Ill. The new department, plans for which were recently completed, was put in operation Nov. 1.

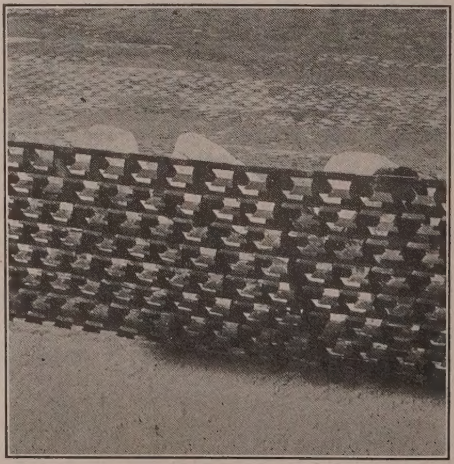
Turner Patents Defeated

Two patent cases involving Turner patents 985,119 and 1,003,384 were recently decided by the United States Circuit Court of Appeals. The case of Turner vs. Deere & Webber involved only the earlier patent. Judge Orr, following the ruling of the Circuit Court of Appeals of the Eighth District, declared claims 1, 4 and 6 of that document to be invalid.

In the case of Turner vs. the Lauter Piano Company both patents were involved. The decision would seem to settle, for all time, claims which Mr. Turner has made since his earlier losses in the courts. The recent decision by the New Jersey court is that both patents are invalid for lack of invention; that they are infringements on the Norcross patents owned by the Flat Slab Patents Company, Chicago.

Armored-Concrete Road Costs $2.06 per Square Yard

A steel road surface, called "armored concrete" by its inventor, J. F. Wixom, of Hammondsport, N. Y., is being tested by Charlotte, N. C. The cost of a trial section 80 ft. long covering 160 sq. yd. has been estimated at $2.06 per square yard. Concrete of 1:2:3 mixture, with ¾-in. stone, is laid 3 in. thick on a 4-in. stone base. The lugs shown in the picture are made by blocking out No. 11 gage steel in a pressing machine. Each section is 30 in. wide and 18 ft. long. Slots on the edge of one section take the lugs on the next.

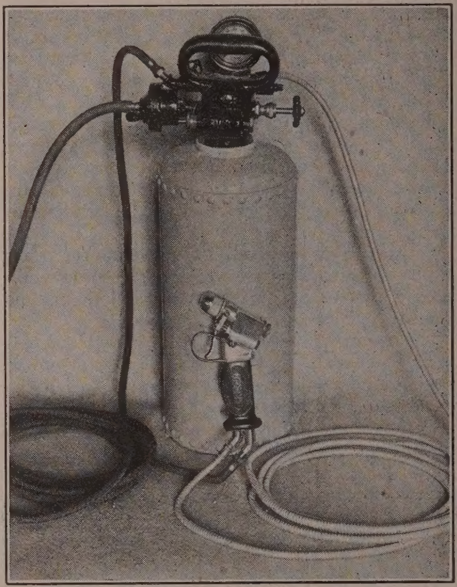


STEEL SECTION UP-ENDED

Paint Gun Used for All Kinds of Painting

A nozzle which has been in use for about three years for cooling ponds, sewage sprays and other work has been redesigned and fitted for use as a paint gun. The Spraco paint gun, as the new device is known, is manufactured by the Spray Engineering Company, 93 Federal Street, Boston, "for all kinds of painting."

The complete equipment consists of the paint gun proper connected by flexible hose to a portable unit combining, in a compact, rugged form, the material container, air drier and strainer, pressure-control attachment, and pressure gage. After the portable control head has been adjusted to meet the conditions of air pressure, thickness of paint, etc., the operator has complete control of the outfit by means of the trigger on the paint gun proper. The unit is furnished complete ready for attachment by a single-hose connection to the compressed air supply, which should be from 35 to 75 lb. per square inch, depending on the nature of the material used and the degree of finish required.



PAINT GUN USED IN FIELD OR SHOP

The equipment is adapted for use in shop or field and may be adjusted for spraying the highest grade of varnishes and lacquers, as well as heavy asphaltum and structural paints. The manufacturer states that this gun produces surfaces without streaks or brush marks. It is also adapted to applying heavy durable coatings to rough structures and surfaces not easily reached with a brush.

Drill 36-Inch Hole in 3 1-2 Minutes

A 36-in. hole was recently drilled into igneous mica rock in New York City in 3 minutes 37 seconds. The 20-in. starter, 1¾ in. in diameter, was drilled in 2 minutes 7 seconds; the 16-in. hole, 1⅝ in. across, was made in 1 minute 30 seconds. "Hummer" drills, made by the Chicago Pneumatic Tool Company, were used. In another test a hole 10 ft. deep, varying from 2¼ to 1¾ in. in diameter, was drilled in 11 minutes 35 seconds.

Business Notes

The Sullivan Machinery Company, of Chicago, has transferred Burt B. Brewster from Juneau, Alaska, to Salt Lake City to take charge of that branch. Walter F. O'Brien will succeed Mr. Brewster at Juneau.

The Witherow Steel Company, of Pittsburgh, has opened a district office at 120 Broadway, New York City.

The Chain Belt Company, of Milwaukee, has appointed C. F. Messinger manager of the mixing department. He is a graduate of Yale University.